Floristic Survey of Remnant Vegetation and Revegetation in the Coorong, Lower Lakes and Murray Mouth Region

November 2015

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Prepared for the Department of Environment, Water and Natural Resources, as part of the Coorong, Lower Lakes and Murray Mouth Recovery Project, November 2015.

Document Information

Client	Department for Environment, Water and Natural Resources
Issue Date	9 December 2015
Version	2.1
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Document History

Version	Issue Date
1.0	13 November 2015
2.0	4 December 2015
2.1	9 December 2015

Certain assumptions have been made in the preparation of this report. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

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Acknowledgements

This project was funded under the Coorong, Lower Lakes and Murray Mouth Recovery Project by the South Australian Government's Murray Futures program and the Australian Government. Thanks also to landholders who provided access to sites, as well as advice and support, Regina Durbridge from the Goolwa to Wellington LAP Group, and Kevin from the Raukkan community.

Australian Government

Government of South Australia

Executive summary

The Coorong, Lower Lakes Murray Mouth Program (CLLMM) has undertaken an extensive program of revegetation in the Lower Lakes / Coorong area to increase resilience and connectivity of native habitats, and provide valuable refuges for the region's native flora and fauna. The intent of this project was to gather data to provide an indication of how successful the program has been in recreating the structure and function of target vegetation communities to date, and to form a baseline for future monitoring.

Quadrat based data were gathered from 100 sites in the Coorong, Lower Lakes Murray Mouth Program area in spring of 2015 using a method analogous to the Biological Survey of South Australia methodology. Twenty sites were located in areas with remnant vegetation, and 80 sites were located in areas where revegetation has been undertaken.

Sites were allocated to an ecosystem type, based upon soil type, vegetation and location in the landscape. All sites were located in 5 specified ecosystem types. Within each site, 9 randomly chosen 10 metre by 10 metre quadrats were surveyed for the type, cover and dominance of all species present. Observations were also gathered on key management issues within each site.

Native species richness was generally higher in remnant sites than revegetation sites. Sites in samphire vegetation types (ecosystem 9) were the exception to this general rule, with the number of native species roughly analogous. Native species richness was generally higher in remnant sites than revegetation sites. Sites in samphire vegetation types (ecosystem 9) were the exception to this general rule, with the number of native species roughly analogous. Introduced species richness was highest in revegetation in all ecosystem types aside from the samphire community, and was also high in remnant vegetation in Mallee and Blue Gum woodlands.

Commonly occurring species of high cover for remnant vegetation included a much greater variety of lifeform types (such as climbers/twiners, sedges, grasses and herbs) than revegetation sites, which were only represented by trees, shrubs and the sedge *Ficinia nodosa*. In revegetation commonly occurring species of high cover were most often introduced, with grassy and herbaceous species prominent.

A number of key management issues were identified, with grassy weed invasion being most commonly encountered. Perennial Veldt Grass was extensive in most vegetation types, and is considered to be a major obstacle to restoration towards a target remnant state at many sites. It is recommended that future survey work is undertaken to clarify progress of revegetation towards states that are analogous to remnant vegetation.

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1.0 Introduction:

The Coorong, Lower Lakes Murray Mouth Program (CLLMM) began in 2009 as part of the Commonwealth's Bioremediation and Revegetation Project. Works were undertaken as an emergency response to the prolonged drought. Before water returned to the Lower Lakes system, mid-2010, the Bioremediation and Revegetation Project (BRP)was designed to build community resilience and support for the broader program through involvement and capacity building of local community groups to have the skills, experience and equipment necessary to be involved in the ongoing environmental care of the region.

The BRP has now transitioned from emergency works to habitat restoration through revegetation of the Coorong Lower Lakes region, and is now part of the Commonwealth's broader Murray Futures Initiative. The Vegetation Program was funded for five-years (2011 - 2016) and is now one of Australia's largest revegetation programs. It has tackled the ecological problems of the region at a landscape scale by prioritising the vegetation communities to restore, and by determining where restoration activities should occur. Work undertaken includes buffering the edge of the Ramsar wetland by planting terrestrial and semi-aquatic vegetation communities. The Program also restores wetland communities through the planting of native sedge species around Lakes Alexandrina and Albert. These plantings are intended to help reduce shoreline erosion, reduce the risk of acid sulphate soils, facilitate the establishment of diverse terrestrial and aquatic plant communities, and provide habitat for fish, birds and other fauna and improve water quality. These activities aim to increase resilience and connectivity of native habitats, and provide valuable refuges for the region's native flora and fauna.

The purpose of this project is to gather data to understand how successful the program has been in recreating the structure and function of target communities to date. The data will also form a baseline for both future research and monitoring. Specific data is also gathered at each site to enable key management issues to be identified.

2.0 Methods:

One hundred sites were chosen across the Coorong Lower Lakes program area (Figure 1). Twenty sites were located in areas with remnant vegetation, and 80 sites were located in areas where revegetation has been undertaken. Remnant and revegetated areas were allocated into Ecosystem types based on the dominant vegetation and soil types present at a site, along with location in the landscape. This allocation was undertaken based on soil type, vegetation and location in the landscape using ecosystems described in Jellinek and Te 2014[1].

Landholders were contacted for permission to access the sites, and to provide any detail required regarding access.

Within each site, nine survey points were randomly generated. In remnant sites these were located within a 2 hectare area, and in revegetation sites the points were located within areas that have been mapped by the CLLMM program as revegetation.

[1] Jellinek, S. & Te, T. 2015. A guide to restoring the Coorong, Lower Lakes and Murray Mouth region, Adelaide, SA., Vegetation Program, Department of Environment, Water and Natural Resources.

At each survey point, a quadrat of 10m by 10m was measured out, with the survey point as the centre of the quadrat. Within each quadrat, all plant species were identified to species level, or were vouchered for subsequent identification. For each species, the following attributes were estimated using a modified Braun-Blanquet cover-abundance scale, as shown by the codes and descriptions provided in Appendix 1:

- cover abundance;
- life form;
- strata dominance; and
- life stage.

The ground cover of live plants, dead plants, moss/microphytic crust, bare ground and rock was also estimated and categorised as per the codes in Appendix 1. A photograph was taken of each quadrat, from the midpoint of the northern boundary of the site facing towards the centre, except where the view was impeded (e.g. by plants) in which case another side of the quadrat was chosen.

Opportune data was also gathered at each site to provide an overview of ongoing management issues. These data were intended to provide a list of actions aimed at facilitating survival and recruitment of native plant species associated with the ecosystem type identified for each site. The datasheet used for this purpose is provided in Appendix 1. Sites were sampled between 21st September and 26th October 2015, corresponding to the time period when plants were most readily identifiable, particularly grasses.

2.1 Data analysis:

Individual t-tests were performed for each ecosystem type to detect where significant differences occurred between remnant and revegetated sites. Individual ecosystem descriptions (section 3) were also compiled for both remnant and revegetated areas.

There were 3 species, *Sagina maritima, Heliotropium europaeum* and *Helichrysum luteoalbum*, that are considered to be "questionably native[2]". These are cosmopolitan species for which are currently considered to be likely (but not certain) to have been part of the original pre-European Australian flora. Thus for the purposes of this report they have been considered as native species.

[2] Census of South Australian Plants accessed 11/11/2015: http://flora.sa.gov.au/

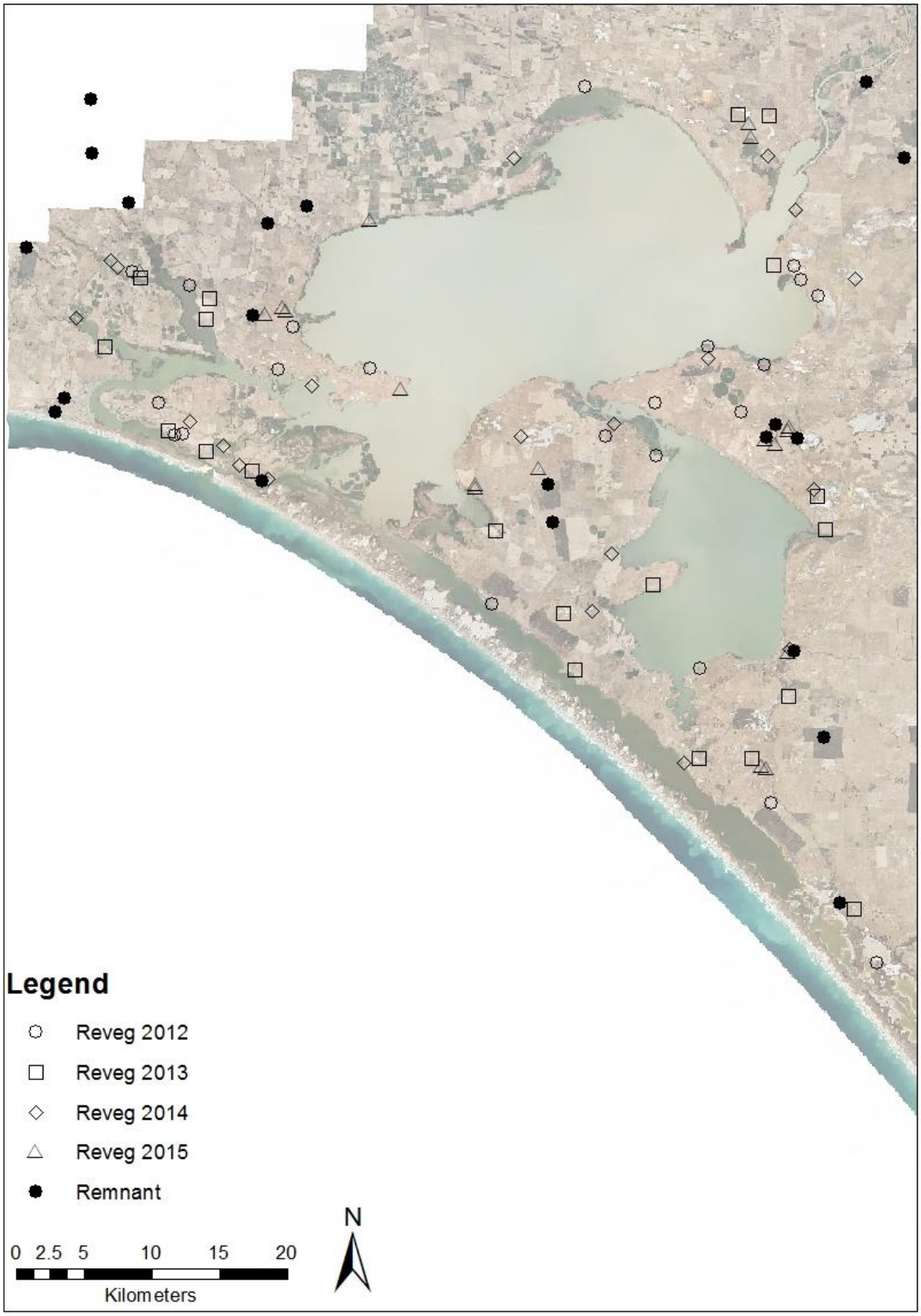

Figure 1: Location of survey sites within the CLLMM region.

3.0 Results

Nine hundred quadrats were analysed across one hundred different sites, generating over 15,000 individual species records of 181 weed and 454 native species. Appendix 2 describes the characteristics of each ecosystem type. All remnant types were sampled at four sites, with revegetation types sampled at 10 to 22 sites (Table 1).

Table 1: Number of remnant and revegetation sites surveyed by ecosystem type

Ecosystem number	Ecosystem description	Number of remnant sites	Number of revegetation sites
1	Pink Gum (*Eucalyptus fasciculosa*) Low Open Grassy Woodland of the Mount Lofty Ranges	4	11
4/5	Coastal white mallee and Sheoak shrubby woodlands/mallee including 4. *Eucalyptus diversifolia* Mallee Communities of the South East and 5. Sheoak (*Allocasuarina verticillata*) low woodland with shrubby understorey	4	22
6	Mallee and Blue Gum Woodlands including 6.1 Mallee Box (*Eucalyptus porosa*) Grassy Woodland, 6.2 Peppermint Box (*Eucalyptus odorata*) Grassy Woodland, 6.3 *Eucalyptus incrassata / E. leptophylla +/- E. socialis* Mallee Community and 6.4 *Eucalyptus leucoxylon* Grassy Woodland	4	17
9	Samphire (+/- *Melaleuca halmaturorum*) Shrubland Community	4	20
10.4	Non Eucalypt (*Allocasuarina verticillata* and *Callitris gracilis*) Grassy Woodland	4	10

Species richness

Native species richness was highest in remnant vegetation in ecosystems 1, 4, 6 and 10, all of which averaged in excess of 50 species at the site level (Figure 2), and 20 species per 10m by 10m quadrat (Figure 3). Contrastingly, revegetation sites all averaged 30 or less native species per site (Figure 2) and ten or less species per quadrat (Figure 3). Ecosystem 9 was the exception, with the number of native species roughly analogous in both sites and quadrats for remnant and revegetation sites (Figures 2, 3). Individual t-tests between remnant and revegetated sites for each ecosystem showed native richness was significantly higher for remnant vegetation in all ecosystem types aside from ecosystem 9, the samphire vegetation type (Tables 3,4). In most of the revegetation sites in this samphire community the degree of remnancy was quite high, which may explain this pattern (refer Section 3.1).

Weedy species showed a less distinctive pattern. The highest mean introduced species richness for both quadrats and at the site level was found in revegetation sites aside from 9, and in remnant vegetation in ecosystem 6 (Figures 6,7). In general there was a higher species richness of introduced species in revegetated sites, aside from ecosystem type 6. All ecosystems aside from 10.4 showed significant differences in introduced species richness between remnant and revegetated sites using the quadrat data (Table 4). When whole of site data was considered, significant differences occurred only in ecosystem types 1 and 9. The discrepancy between site and quadrat data may be due to the higher degree of replication using quadrat data increasing statistical power rather than any real difference between the site and quadrat data. The lowest introduced species counts were observed in remnant vegetation in ecosystem 9, which is a samphire community.

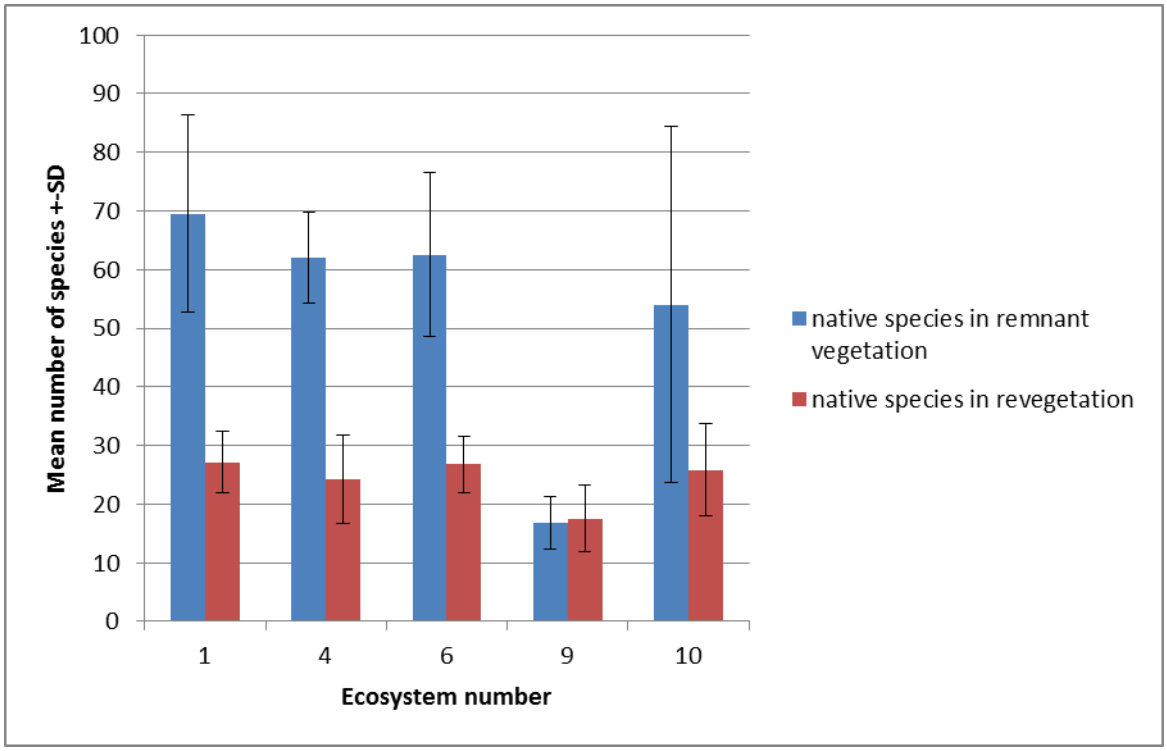

Figure 2: Mean species richness by site for native species for sites in remnant vegetation and revegetation in different ecosystem types

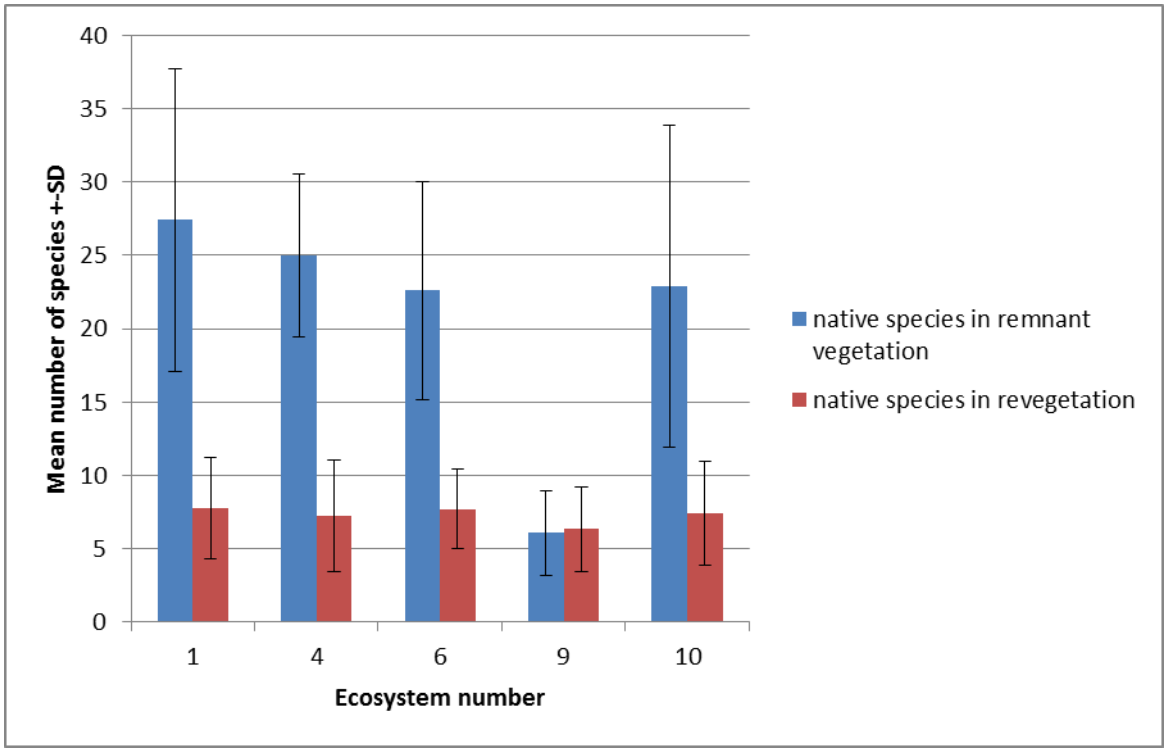

Figure 3: Mean species richness by 10m by 10m quadrat for native species for sites in remnant vegetation and revegetation in different ecosystem types

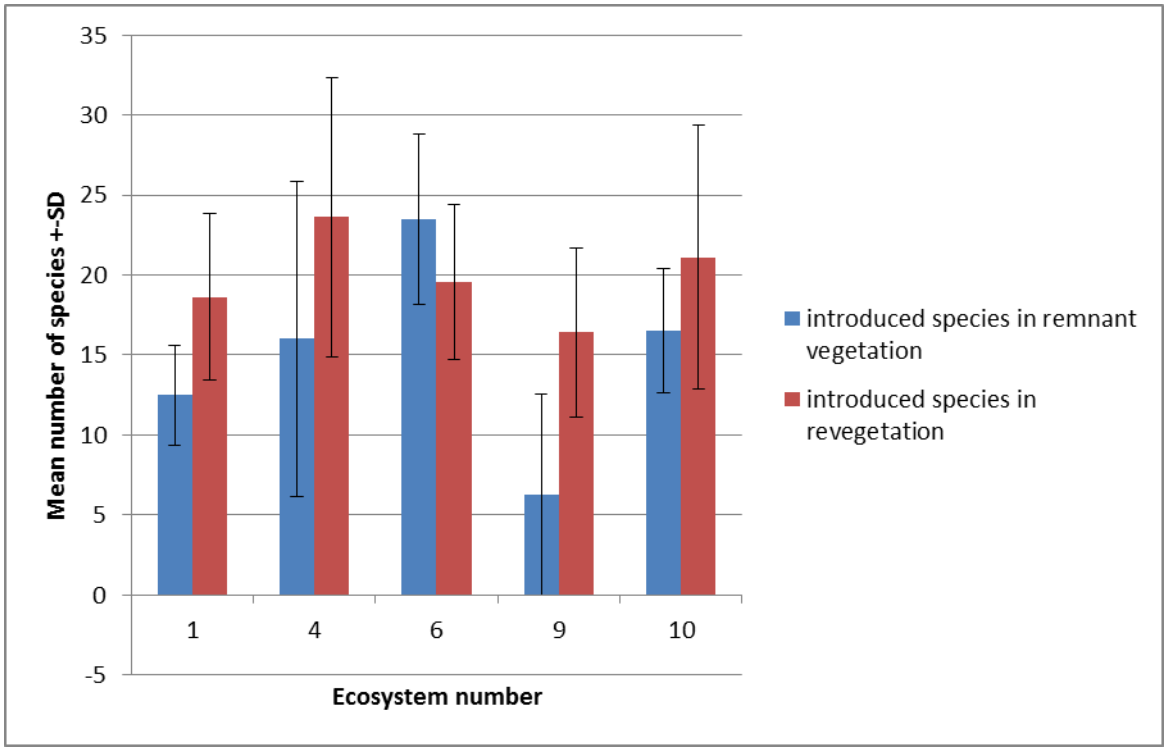

Figure 4: Mean species richness by site for introduced species for sites in remnant vegetation and revegetation in different ecosystem types

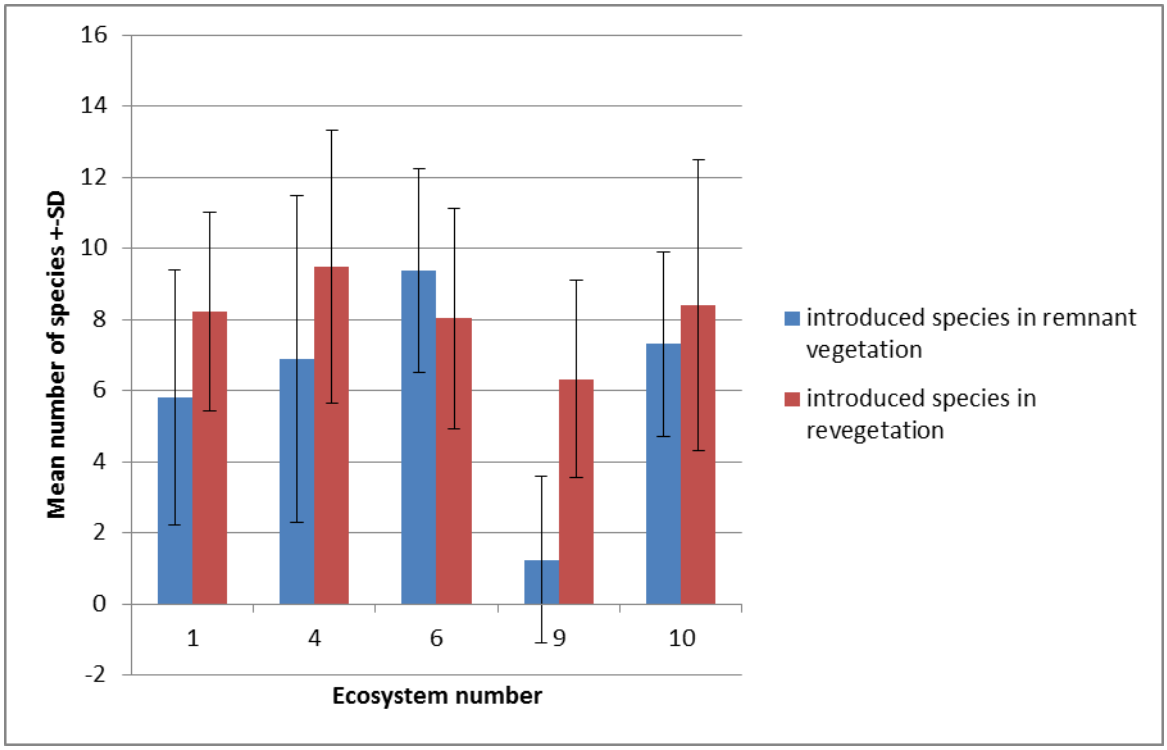

Figure 5: Mean species richness by 10m by 10m quadrat for introduced species for sites in remnant vegetation and revegetation in different ecosystem types

Table 3: Comparison of total site native species richness for remnant and revegetation by ecosystem type

Ecosystem number	Native Species t-stat	Introduced Species t-stat	Degrees of Freedom
1	7.81***	-2.17*	13
4/5	9.10***	-1.58 NS	24
6	9.01***	1.43 NS	19
9	-0.26 NS	-3.41**	22
10.4	2.86**	-1.05 NS	12

NS= not significant,*P<0.05, **P<0.01, ***P<0.001

Table 4: Comparison of quadrat native species richness in remnant and revegetation sites by ecosystem type

Ecosystem number	Native Species	Introduced Species	Degrees of Freedom
1	16.6***	-4.10***	133
4/5	23.7***	-3.61***	232
6	19.9***	2.42*	187
9	-0.49 NS	-10.3***	214
10.4	12.0***	-1.50 NS	124

NS= not significant,*P<0.05, **P<0.01, ***P<0.001

Cover of native and introduced species

Revegetation sites overall contained many introduced species of high cover (>5%) when compared to remnant sites (Figure 6). In revegetation sites, over two thirds of the native species observed were categorised as "not many, 1-10 individuals". This in many cases is likely to be planted tree and shrub species, which are currently subadult, and may in future cover a greater area and therefore move into a higher cover category.

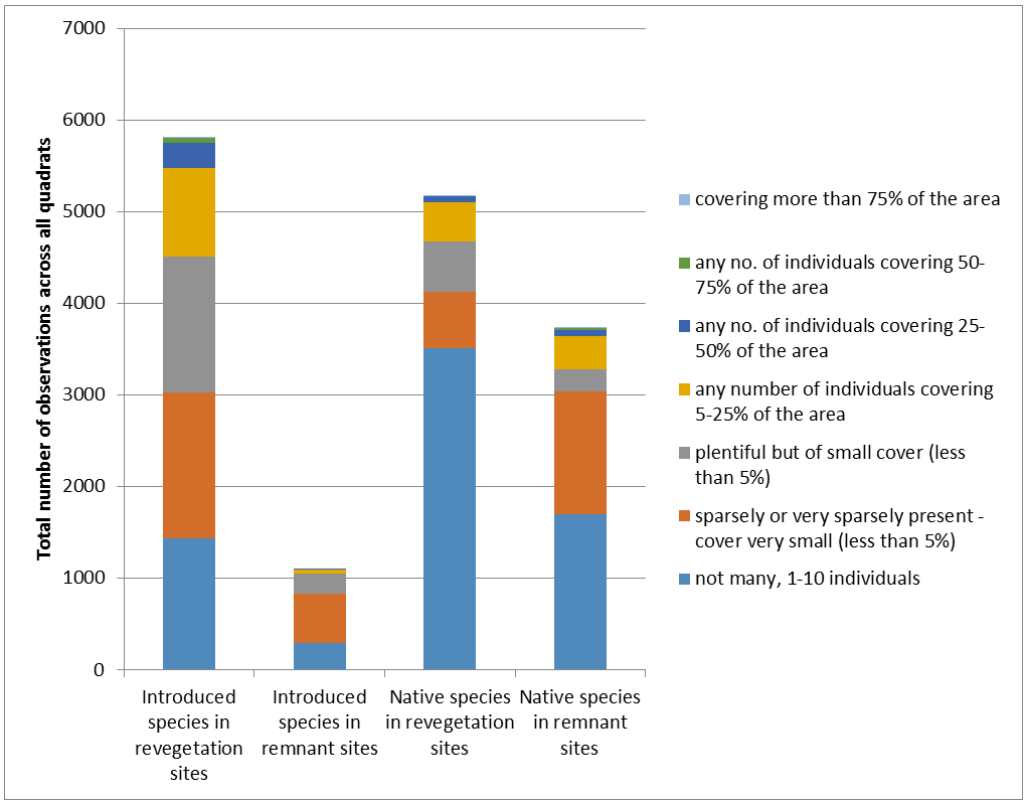

Figure 6: Comparison of cover category observations for native and introduced species for all Ecosystems

Observations of cover for native and introduced species for each individual ecosystem is shown in Figures 7 to 11, and summarised below:

Ecosystem 1: Pink Gum (*Eucalyptus fasciculosa*) Low Open Grassy Woodland of the Mount Lofty Ranges

Introduced species generally belonged to the lower cover categories (<5%) within remnant sites, whereas in revegetation sites about one fifth of all introduced species observed were of cover >5% (Figure 7). Over ¾ of all native species recorded in revegetation sites were categorised as "not many, 1-10 individuals", with few (<10%) categorised as plentiful or >5% cover. In remnant sites, native species were most commonly recorded as not many or sparsely present, with about 20% recorded as either plentiful but small cover or >5% cover.

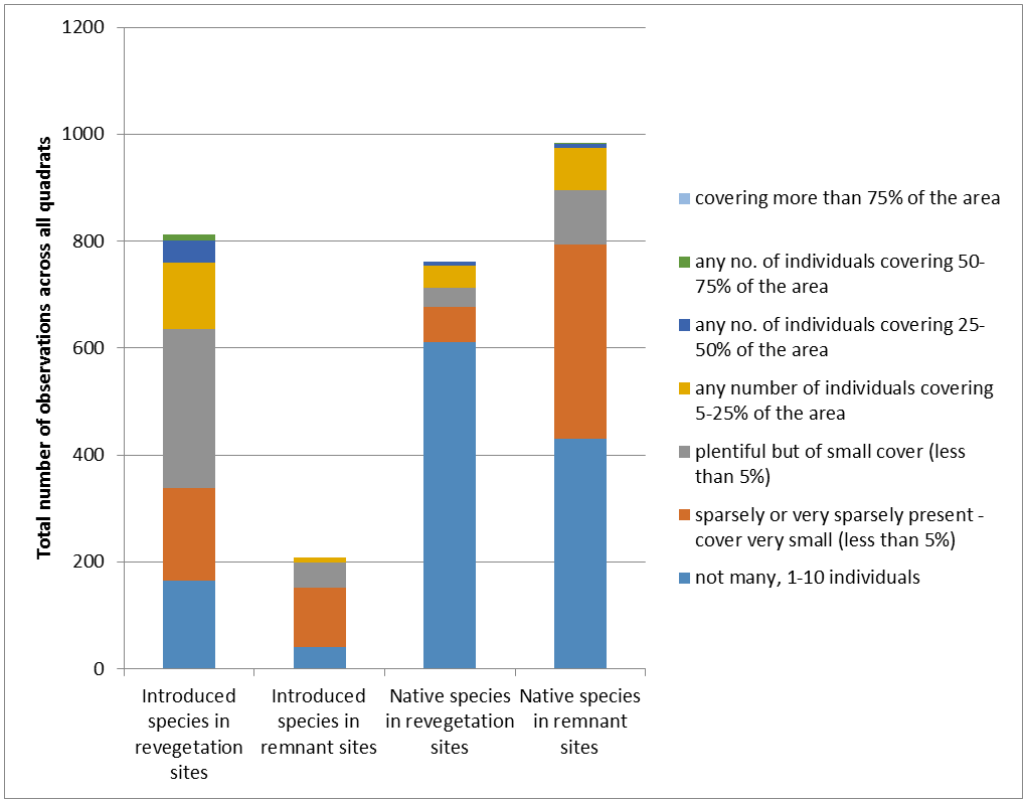

Figure 7: Comparison of cover category observations for native and introduced species for Ecosystem 1: Pink Gum (*Eucalyptus fasciculosa*) Low Open Grassy Woodland of the Mount Lofty Ranges

Ecosystem 4/5: Coastal white mallee and Sheoak shrubby woodlands/mallee

Introduced species generally belonged to the lower cover categories (<5%) within remnant sites, whereas in revegetation sites about one fifth of all introduced species observed were of cover >5%. Over two thirds of all native species recorded in revegetation sites were categorised as "not many, 1-10 individuals", with few (<15%) categorised as plentiful or >5% cover. In remnant sites, native species were most commonly recorded as not many or sparsely present, with about 10% recorded as either plentiful but small cover or >5% cover.

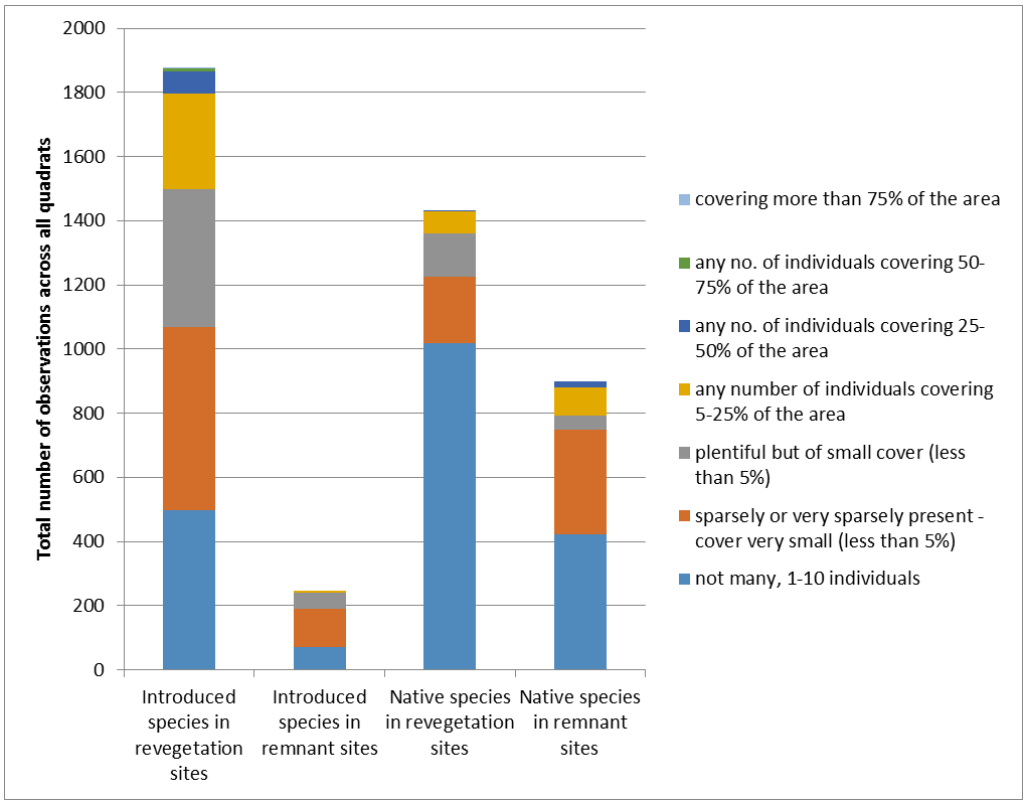

Figure 8: Comparison of cover category observations for native and introduced species for Ecosystem 4/5: Coastal white mallee and Sheoak shrubby woodlands/mallee

Ecosystem 6: Mallee and Blue Gum Woodlands

Introduced species generally belonged to the lower cover categories (<5%) within remnant sites, whereas in revegetation sites about one fifth of all introduced species observed were of cover >5%. About two thirds of all native species recorded in revegetation sites were categorised as “not many, 1-10 individuals”, with about one fifth categorised as plentiful or >5% cover. In remnant sites, native species were most commonly recorded as not many or sparsely present, with about 20% recorded as either plentiful but small cover or >5% cover.

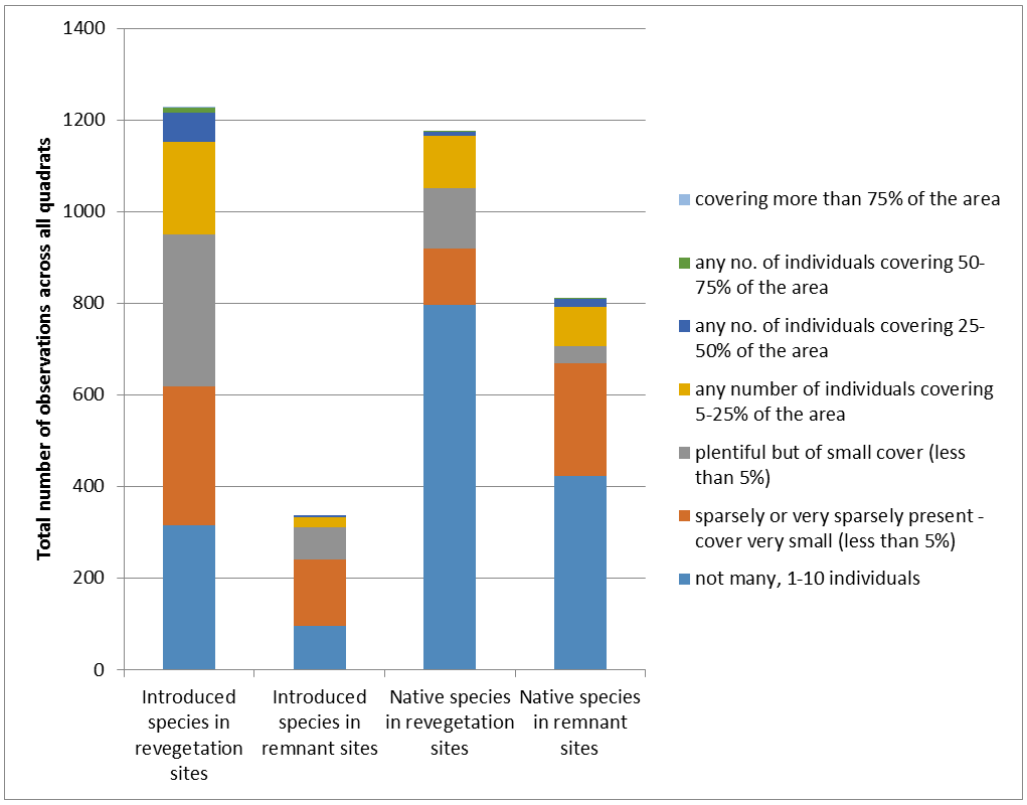

Figure 9: Comparison of cover category observations for native and introduced species for Ecosystem 6: Mallee and Blue Gum Woodlands

Ecosystem 9: Samphire (+/- *Melaleuca halmaturorum*) Shrubland Community

Ecosystem 9 shows different patterns with regard to cover of native and introduced species than other ecosystem types. As noted previously, species diversity is relatively low for this ecosystem type, due to the harsh nature of the environment in which it occurs (i.e. exposure to inundation and high salinity levels). In contrast to other ecosystem types, it was also noted that there was existing remnant vegetation in many of the revegetation sites. This explains the higher number of observations of native species of cover of 5% or greater in revegetation sites (Figure 10) in comparison to other ecosystem types (Figures 7, 8, 9, 11). In common with other ecosystems, introduced species generally belonged to the lower cover categories (<5%) within remnant sites, whereas in revegetation sites over one fifth of all introduced species observed were of cover >5%. There were still many observations for native species in revegetation of "not many, 1-10 individuals", with over half of all observations fitting this category.

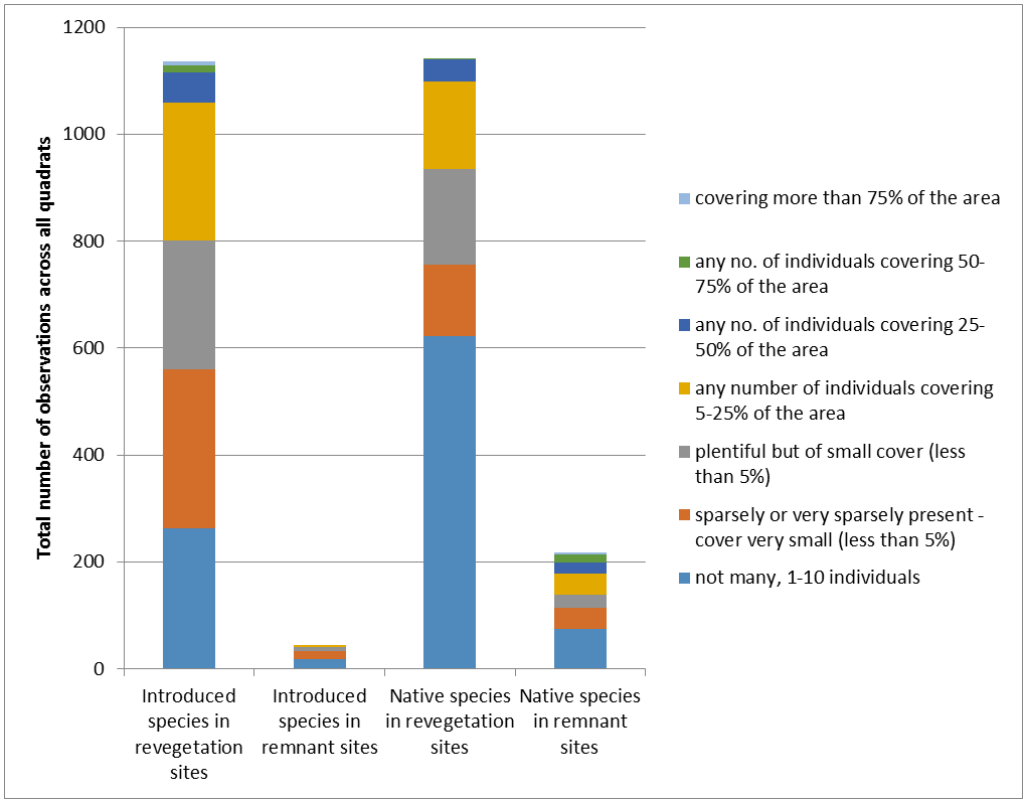

Figure 10: Comparison of cover category observations for native and introduced species for Ecosystem 9: Samphire (+/- *Melaleuca halmaturorum*) Shrubland Community

Ecosystem 10.4: Non Eucalypt (*Allocasuarina verticillata* and *Callitris gracilis*) Grassy Woodland

This ecosystem showed similar patterns to Ecosystems 1,4/5 and 6, with introduced species being more common in the higher (>5%) cover category for revegetation rather than remnant sites, and high proportion of observations of native species in revegetation sites belonging to the "not many, 1-10 individuals" category when compared to remnant sites . Native species in remnant sites were also more frequently recorded in higher (>5%) cover categories than in revegetation sites. As current plantings grow this pattern may change.

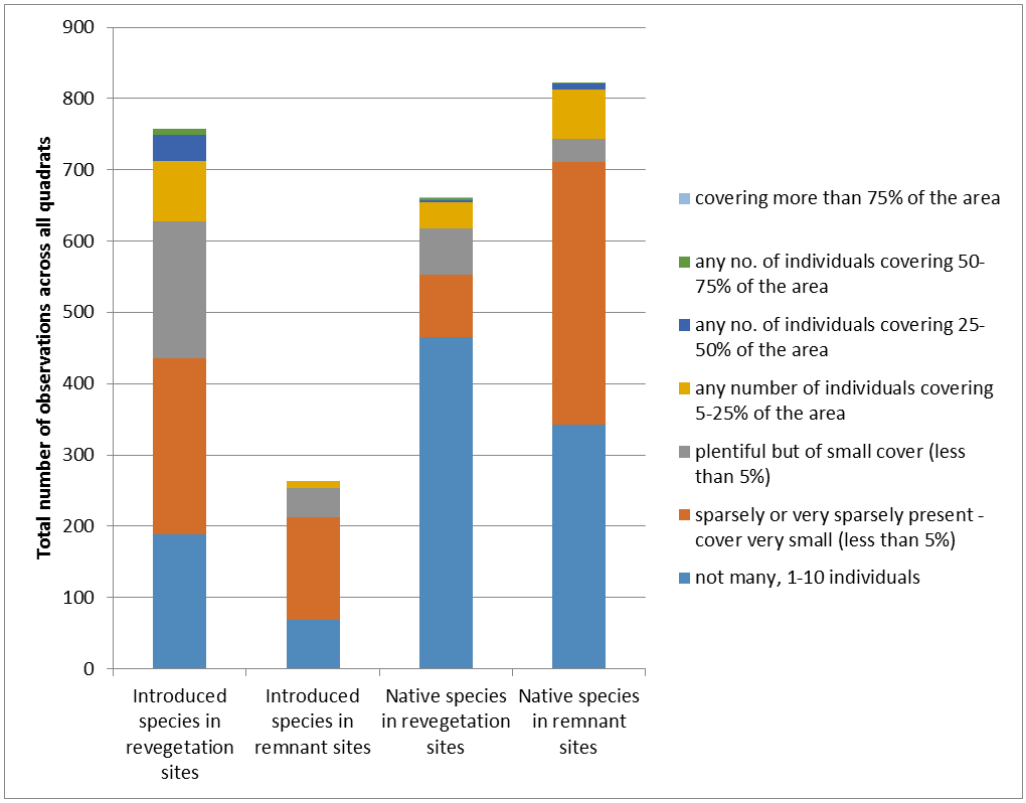

Figure 11: Comparison of cover category observations for native and introduced species for Ecosystem 10.4: Non Eucalypt (*Allocasuarina verticillata* and *Callitris gracilis*) Grassy Woodland

Commonly occurring native and introduced species of high cover

The differences between remnant and revegetation sites are also apparent when comparing commonly occurring species of high cover. Of the 23 species commonly recorded as >5% cover, fourteen are introduced species in revegetation sites (Table 5). All of these species are either herbaceous or grassy. Perennial Veldt Grass (*Ehrharta calycina*) is found as the most commonly occurring species of high (>5%) cover at revegetation sites, and is especially prevalent in ecosystems on sandy soils (Ecosystems 1, 4/5 and 10.4). Of the 9 native species commonly recorded as high cover in revegetation sites, some are from existing remnant vegetation (such as *Tecticornia spp*.), and some are previous revegetation prior to the CLLMM program and/or existing remnant (e.g. *Allocasuarina verticillata*) (T. Milne pers. obs.). Over time, it is likely that increased numbers of native species will occur as high cover in the revegetation sites as the current CLLMM plantings grow and increase in cover.

In remnant sites, only 4 of 37 species commonly recorded as >5% cover are introduced species (Table 6). These species are Bridal Creeper (*Asparagus asparagoides*), the grasses Perennial Veldt Grass (*Ehrharta calycina*) and Annual Veldt Grass (*Ehrharta longiflora*), and the small herb *Plantago bellardii*. Commonly occurring native species of high cover include the trees *Eucalyptus diversifolia ssp. diversifolia*, *Eucalyptus fasciculosa* and *Acacia pycnantha,* which are found across most habitats aside from samphire communities. Also notable is the presence of a number of sedge and irongrass species (*Lepidosperma spp., Lomandra spp*., *Gahnia spp.*), which were not among the commonly occurring species of high cover in revegetation.

Table 5: Commonly occurring species of high (>5%) cover in revegetation. The numbers shown in brackets after the ecosystem number are the number of quadrats assessed for that ecosystem type. Species that occurred in 20 or more quadrats are included.

		Ecosystem number					
Species name	**N/I***	**1 (99)**	**4 (198)**	**6 (153)**	**9 (180)**	**10.4 (90)**	**Overall (720)**
Ehrharta calycina	Introduced	0.75	0.50	0.06	0.02	0.62	0.33
Bromus diandrus	Introduced	0.20	0.18	0.31	0.14	0.22	0.21
Lolium sp.	Introduced	0.08	0.01	0.18	0.36	0.02	0.14
Avena barbata	Introduced	0.08	0.05	0.26	0.13	0.08	0.12
Medicago polymorpha var. polymorpha	Introduced		0.06	0.08	0.25		0.10
Medicago truncatula	Introduced		0.10	0.02	0.17	0.06	0.08
Euphorbia terracina	Introduced		0.19	0.08		0.08	0.08
Trifolium arvense var. arvense	Introduced	0.33	0.03	0.04		0.07	0.07
Arctotheca calendula	Introduced	0.07	0.05	0.12	0.03	0.02	0.06
Lagurus ovatus	Introduced	0.02	0.06	0.10	0.04	0.02	0.05
Atriplex paludosa ssp.	Native			0.02	0.18	0.01	0.05
Hordeum leporinum	Introduced		0.01	0.12	0.06	0.04	0.05
Tecticornia sp.	Native		0.01		0.19		0.05
Hordeum marinum	Introduced		0.01	0.09	0.09		0.04
Vulpia sp.	Introduced	0.01	0.05	0.11	0.02		0.04
Cynodon dactylon var. dactylon	Introduced	0.02	0.07	0.03	0.04		0.04
Ficinia nodosa	Native	0.02	0.06		0.02	0.12	0.04
Plantago coronopus ssp.	Introduced		0.04	0.01	0.08	0.01	0.03
Allocasuarina verticillata	Native	0.06	0.04	0.04		0.03	0.03
Oenothera stricta ssp. stricta	Introduced	0.01	0.11				0.03
Distichlis distichophylla	Native		0.02	0.04	0.06		0.03
Tecticornia pergranulata ssp.	Native				0.11		0.03
Scabiosa atropurpurea	Introduced	0.06	0.03	0.03		0.01	0.03

*Native or introduced

Table 6: Commonly occurring species of high (>5%) cover in remnant vegetation. The numbers shown in brackets after the ecosystem number are the number of quadrats assessed for that ecosystem type. Species that occurred in 5 or more quadrats are included.

		Ecosystem number					
Species name	**N/I***	**1 (36)**	**4 (36)**	**6 (36)**	**9 (36)**	**10 (36)**	**Overall (180)**
Eucalyptus diversifolia ssp. diversifolia	Native	0.00	0.69	0.19	0.00	0.19	0.22
Eucalyptus fasciculosa	Native	0.56	0.19	0.03	0.00	0.00	0.16
Acacia pycnantha	Native	0.03	0.11	0.36	0.00	0.14	0.13
Xanthorrhoea caespitosa	Native	0.00	0.22	0.06	0.00	0.31	0.12
Callitris gracilis	Native	0.00	0.06	0.00	0.00	0.44	0.10
Hibbertia riparia	Native	0.14	0.19	0.08	0.00	0.08	0.10
Asparagus asparagoides f.	Introduced	0.06	0.19	0.17	0.00	0.06	0.09
Lepidosperma carphoides	Native	0.03	0.25	0.03	0.00	0.11	0.08
Acacia paradoxa	Native	0.17	0.08	0.14	0.00	0.00	0.08
Sarcocornia quinqueflora	Native	0.00	0.00	0.00	0.36	0.00	0.07
Eucalyptus odorata	Native	0.11	0.00	0.25	0.00	0.00	0.07
Allocasuarina verticillata	Native	0.00	0.22	0.00	0.00	0.11	0.07
Tecticornia sp.	Native	0.00	0.00	0.00	0.31	0.00	0.06
Melaleuca halmaturorum	Native	0.00	0.00	0.00	0.31	0.00	0.06
Ehrharta longiflora	Introduced	0.06	0.00	0.22	0.00	0.03	0.06
Tecticornia halocnemoides ssp.	Native	0.00	0.00	0.00	0.31	0.00	0.06
Kunzea pomifera	Native	0.00	0.03	0.00	0.00	0.25	0.06
Eucalyptus cosmophylla	Native	0.28	0.00	0.00	0.00	0.00	0.06
Gahnia deusta	Native	0.00	0.11	0.17	0.00	0.00	0.06
Lepidosperma concavum/congestum/laterale	Native	0.25	0.00	0.03	0.00	0.00	0.06
Leptospermum myrsinoides	Native	0.19	0.08	0.00	0.00	0.00	0.06
Ehrharta calycina	Introduced	0.06	0.00	0.08	0.00	0.11	0.05
Plantago bellardii	Introduced	0.11	0.03	0.03	0.00	0.08	0.05
Bursaria spinosa ssp. spinosa	Native	0.00	0.06	0.17	0.00	0.00	0.04
Gahnia filum	Native	0.00	0.00	0.00	0.19	0.00	0.04
Olearia ramulosa	Native	0.00	0.14	0.00	0.00	0.06	0.04
Eucalyptus leucoxylon ssp. leucoxylon	Native	0.00	0.00	0.19	0.00	0.00	0.04
Melaleuca acuminata ssp. acuminata	Native	0.00	0.00	0.19	0.00	0.00	0.04
Pultenaea canaliculata	Native	0.19	0.00	0.00	0.00	0.00	0.04
Samolus repens	Native	0.00	0.00	0.00	0.19	0.00	0.04
Allocasuarina pusilla	Native	0.00	0.11	0.00	0.00	0.08	0.04
Melaleuca uncinata	Native	0.06	0.00	0.11	0.00	0.00	0.03
Enchylaena tomentosa var.	Native	0.00	0.00	0.00	0.03	0.11	0.03
Suaeda australis	Native	0.00	0.00	0.00	0.14	0.00	0.03
Eucalyptus porosa	Native	0.00	0.00	0.14	0.00	0.00	0.03
Lepidosperma congestum	Native	0.00	0.06	0.08	0.00	0.00	0.03
Lomandra effusa	Native	0.00	0.00	0.11	0.00	0.03	0.03

*Native or introduced

Management Issues

A number of management issues were identified whilst undertaking the surveys, and they were broadly grouped into the following categories:

- Herbaceous Weeds
- Grassy Weeds
- Woody Weeds
- Vine Weeds
- Bulbous weeds
- *Juncus acutus*
- Domestic Grazing
- Rabbits/Hares
- Foxes
- Kangaroos
- Snails
- Plant death
- Inappropriate species
- Tree guards require removal
- Buffers need to be sprayed or slashed around plantings
- Weeds growing in tree guards and compromising the tubestock within
- Dead tubestock never planted or not planted well

These management issues are listed by site in Appendix 3. An Excel spreadsheet which provides detail for each site on these issues has been provided to the CLLMM program. Note this is not considered to be a comprehensive list, as it is based on a once-off, brief visit to the site. However, it does provide an indication of some of the ongoing management that will be required.

Table 5 shows that grassy weeds were considered the most prevalent management issue across all sites. Section 3.1 shows that Perennial Veldt Grass, *Ehrharta calycina*, is a common weed in all ecosystem types other than 9: Samphire shrubland, and will provide ongoing management issues. Rabbits and hares were also noted to be impacting on many sites, especially in ecosystem 4/5. Plant death was also noted as a significant management issue in a total of 25 sites (out of 80 surveyed). This plant death was generally due to lack of rainfall/moisture causing dehydration, which is not uncommon in tubestock plantings, especially in drier (<500mm rainfall) areas (T. Milne pers. obs.).

Table 5: Key management issues for revegetation sites in different ecosystem types

	Percentage of sites effected				
	Ecosystem number				
Management Issues	**1**	**4/5**	**6**	**9**	**10.4**
Grassy Weeds	100	86	82	90	100
Herbaceous Weeds	18	77	76	50	40
Rabbits/Hares	27	77	29	5	50
Plant death	36	41	24	40	0
Woody Weeds	36	32	24	20	40
Vine Weeds	27	18	0	5	20
Kangaroos	36	14	0	5	20
Foxes	27	9	6	10	10
Tree guards require removal	9	0	12	15	30
Buffers need to be sprayed or slashed around plantings	45	14	6	0	0
Inappropriate species	18	5	12	0	20
Bulbous weeds	36	9	0	0	0
Snails	0	5	6	0	10
Weeds growing in tree guards and compromising the tubestock within	0	5	12	0	0
Domestic Grazing	0	0	0	10	0
Dead tubestock never planted or not planted well	0	5	0	5	0
Juncus acutus	0	5	0	0	0
Total number of sites in this ecosystem type	11	22	17	20	10

3.1 Descriptions of ecosystems

Ecosystem Number: 1 Pink Gum (*Eucalyptus fasciculosa*) Low Open Grassy Woodland of the Mount Lofty Ranges

Within this ecosystem type there was a consistently higher number of native species in remnant vegetation than in revegetation (refer to Section 3.0). Introduced species were more prevalent in revegetation sites. Species of high cover in remnant vegetation were principally native, and included trees, shrubs, sedges, grasses and herbs. Conversely species of high cover in revegetation sites were mostly introduced, and there were only two life forms for native species that were of high cover (trees and ferns), with the fern Bracken likely to be remnant rather than a revegetation species.

Remnant

Sites included in this ecosystem type: 107, 108, 109, 127

Description of ecosystem: Sites allocated to this ecosystem were generally heathy low woodlands on sandy soils, with Pink Gum (*Eucalyptus fasciculosa*) present in all sites. Mean native species richness was moderate to high, with *Ehrharta calycina* and *Asparagus asparagoides* being the most predominant threatening weed species. Commonly occurring species of high cover were generally native, including trees (*Eucalyptus fasciculosa, Eucalyptus cosmophylla, Eucalyptus odorata*), sedges (*Lepidosperma spp.*), and small and medium shrubs. The exceptions were the small weedy herb *Plantago bellardii* and Annual and Perennial Veldt Grass (*Ehrharta longiflora, Ehrharta calycina*) and Bridal Creeper (*Asparagus asparagoides*).

Indicative Photographs:

Site : 107 *Eucalyptus fasciculosa ssp. fasciculosa* Low Woodland

Site 108: *Eucalyptus fasciculosa* Woodland

Overall site and quadrat data:

Number of sites in this vegetation type: 4
Number of quadrats in this vegetation type: 36
Mean native plant species richness per site (±SD): 69.5 (16.8)
Mean introduced plant species richness per site (±SD): 12.5 (3.1)
Mean native plant species richness per quadrat (±SD): 27.3 (10.3)
Mean introduced plant species richness per quadrat (±SD): 5.81 (3.57)

Most commonly occurring species (proportion of sites):

Native:	Proportion of sites:	Introduced:	Proportion of sites:
Neurachne alopecuroidea	1	*Asparagus asparagoides f.*	1
Daucus glochidiatus	1	*Aira sp.*	1
Arthropodium strictum	1	*Vulpia sp.*	1
Eucalyptus fasciculosa	1	*Moraea setifolia*	0.5
Lepidosperma carphoides	0.75	*Arctotheca calendula*	0.5
Drosera macrantha ssp. planchonii	0.75	*Rostraria cristata*	0.5
Pyrorchis nigricans	0.75	*Ehrharta calycina*	0.5
Astroloma humifusum	0.75	*Lagurus ovatus*	0.5
Acacia spinescens	0.75	*Ehrharta longiflora*	0.5
Austrostipa sp.	0.75	*Plantago bellardii*	0.5
Lomandra juncea	0.75	*Trifolium campestre*	0.5
Billardiera cymosa ssp. cymosa	0.75	*Briza maxima*	0.5
Dianella revoluta var. revoluta	0.75	*Hypochaeris radicata*	0.5
Blennospora drummondii	0.75	*Hypochaeris glabra*	0.5
Drosera whittakeri	0.75	*Hypochaeris sp.*	0.5
Caladenia sp.	0.75		
Hibbertia virgata	0.75		
Clematis microphylla	0.75		
Lepidosperma viscidum	0.75		
Crassula colligata ssp.	0.75		
Lomandra nana	0.75		
Crassula colorata var.	0.75		
Acacia paradoxa	0.75		
Thysanotus patersonii	0.75		

Most commonly occurring species (Proportion of quadrats):

Native:	Proportion of quadrats:	Introduced:	Proportion of quadrats:
Eucalyptus fasciculosa	0.67	*Vulpia sp.*	0.78
Neurachne alopecuroidea	0.58	*Aira sp.*	0.72
Austrostipa sp.	0.56	*Asparagus asparagoides f.*	0.53
Drosera macrantha ssp. planchonii	0.56	*Plantago bellardii*	0.47
Poranthera microphylla	0.47	*Ehrharta calycina*	0.47
Calytrix tetragona	0.44	*Hypochaeris sp.*	0.44
Centrolepis strigosa ssp. strigosa	0.44	*Briza maxima*	0.31
Helichrysum leucopsideum	0.44	*Ehrharta longiflora*	0.28
Gonocarpus tetragynus	0.42	*Hypochaeris glabra*	0.28
Chamaescilla corymbosa var. corymbosa	0.42	*Trifolium campestre*	0.19
Leptospermum myrsinoides	0.42		
Centrolepis aristata	0.42		
Hibbertia riparia	0.42		
Arthropodium strictum	0.39		
Clematis microphylla	0.39		
Boronia coerulescens ssp. coerulescens	0.39		
Lepidosperma carphoides	0.36		
Drosera whittakeri	0.36		
Blennospora drummondii	0.36		
Millotia tenuifolia var.	0.36		
Brachyloma ericoides ssp.	0.36		
Thysanotus patersonii	0.36		

Commonly occurring species of high cover (>5%) (Proportion of quadrats):

Species name	Native / introduced	5-25%	26-50%	51-75%	>75%	Total >5%
Eucalyptus fasciculosa	Native	0.53	0.03			0.56
Eucalyptus cosmophylla	Native	0.25	0.03			0.28
Lepidosperma concavum/congestum/laterale	Native	0.22	0.03			0.25
Leptospermum myrsinoides	Native	0.19				0.19
Pultenaea canaliculata	Native	0.19				0.19
Acacia paradoxa	Native	0.11	0.06			0.17
Hibbertia riparia	Native	0.14				0.14
Eucalyptus odorata	Native	0.08	0.03			0.11
Plantago bellardii	Introduced	0.11				0.11
Xanthorrhoea semiplana ssp. semiplana	Native	0.11				0.11
Ehrharta calycina	Introduced	0.06				0.06
Ehrharta longiflora	Introduced	0.06				0.06
Asparagus asparagoides f.	Introduced	0.06				0.06
Acacia euthycarpa	Native	0.06				0.06
Allocasuarina muelleriana ssp. muelleriana	Native	0.03		0.03		0.06
Melaleuca uncinata	Native	0.03		0.03		0.06
Platylobium obtusangulum	Native	0.06				0.06

Revegetation

Sites included in this ecosystem type: 1, 2, 6, 7, 85, 86, 87, 99, 100, 101, 103

Description of ecosystem: Pink Gum and She-oak were the two most prominent tree species, being present in all bar one of the sites surveyed. Some sites did already have remnant overstorey present, and some remnant understorey present too, which may have contributed to revegetation sites in this ecosystem type having the highest mean native species richness of all of the revegetated ecosystems. Perennial Veldt Grass was present in all bar one of the sites examined, and is also of high cover in ¾ of all sites, so is likely to be an ongoing management issue.

Indicative Photographs:

Site : 1

Site 62

Overall site and quadrat data:

Number of sites in this vegetation type: 11
Number of quadrats in this vegetation type: 99
Mean native plant species richness per site (±SD): 27.2 (5.2)
Mean introduced plant species richness per site (±SD): 18.6 (5.2)
Mean native plant species richness per quadrat (±SD): 7.8 (3.4)
Mean introduced plant species richness per quadrat (±SD): 8.2 (2.8)

Most commonly occurring species (Proportion of sites):

Native:	Proportion of sites:	Introduced:	Proportion of sites:
Allocasuarina verticillata	0.91	*Trifolium arvense var. arvense*	0.91
Dodonaea viscosa ssp. spatulata	0.91	*Vulpia sp.*	0.91
Eucalyptus fasciculosa	0.91	*Ehrharta calycina*	0.91
Leptospermum myrsinoides	0.73	*Arctotheca calendula*	0.82
Ficinia nodosa	0.73	*Bromus diandrus*	0.82
Olearia ramulosa	0.73	*Hypochaeris glabra*	0.82
Bursaria spinosa ssp. spinosa	0.73	*Hypochaeris radicata*	0.73
Billardiera cymosa ssp. cymosa	0.73	*Lolium sp.*	0.73
Melaleuca uncinata	0.64	*Sonchus oleraceus*	0.64
Acacia pycnantha	0.64	*Trifolium subterraneum*	0.64
Acacia paradoxa	0.64	*Lagurus ovatus*	0.55
Clematis microphylla	0.64	*Trifolium campestre*	0.45
Kunzea pomifera	0.55	*Romulea sp.*	0.45
Rhagodia candolleana ssp.	0.55	*Erodium botrys*	0.45
Allocasuarina muelleriana ssp. muelleriana	0.55	*Aira sp.*	0.45
Banksia ornata	0.45	*Disa bracteata*	0.36
Amyema miquelii	0.45	*Lepidium africanum*	0.36
Arthropodium strictum	0.45	*Trifolium angustifolium*	0.36
Austrostipa sp.	0.45	*Avena barbata*	0.36
Eucalyptus baxteri	0.45	*Oenothera stricta ssp. stricta*	0.36
Enchylaena tomentosa var.	0.45		
Dianella brevicaulis	0.45		

Most commonly occurring species (Proportion of quadrats):

Native:	Proportion of quadrats:	Introduced:	Proportion of quadrats:
Eucalyptus fasciculosa	0.55	*Ehrharta calycina*	0.86
Allocasuarina verticillata	0.44	*Trifolium arvense var. arvense*	0.77
Dodonaea viscosa ssp. spatulata	0.43	*Vulpia sp.*	0.54
Olearia ramulosa	0.29	*Hypochaeris glabra*	0.53
Leptospermum myrsinoides	0.27	*Bromus diandrus*	0.52
Billardiera cymosa ssp. cymosa	0.26	*Arctotheca calendula*	0.47
Bursaria spinosa ssp. spinosa	0.22	*Hypochaeris radicata*	0.47
Ficinia nodosa	0.20	*Lolium sp.*	0.36
Acacia pycnantha	0.19	*Trifolium subterraneum*	0.28
Allocasuarina muelleriana ssp. muelleriana	0.19	*Avena barbata*	0.21
Enchylaena tomentosa var.	0.19	*Lagurus ovatus*	0.21
Kunzea pomifera	0.16	*Lolium rigidum*	0.19
Dianella brevicaulis	0.15	*Sonchus oleraceus*	0.18
Clematis microphylla	0.14	*Trifolium campestre*	0.17
Pteridium esculentum ssp. esculentum	0.14	*Brachypodium distachyon*	0.16
Austrostipa sp.	0.14	*Trifolium angustifolium*	0.14
Rhagodia candolleana ssp.	0.13	*Brassica tournefortii*	0.12
Melaleuca uncinata	0.13	*Moraea setifolia*	0.11
Crassula colligata ssp.	0.13	*Erodium botrys*	0.11
Banksia ornata	0.12	*Lepidium africanum*	0.11
Rytidosperma sp.	0.11		
Eucalyptus sp.	0.11		

Commonly occurring species of high cover (>5%) (Proportion of quadrats):

Species name	Native / introduced	5-25%	26-50%	51-75%	>75%	Total >5%
Ehrharta calycina	Introduced	0.34	0.30	0.10		0.75
Trifolium arvense var. arvense	Introduced	0.31	0.02			0.33
Bromus diandrus	Introduced	0.15	0.05			0.20
Eucalyptus fasciculosa	Native	0.07	0.02			0.09
Avena barbata	Introduced	0.03	0.05			0.08
Lolium sp.	Introduced	0.07		0.01		0.08
Pteridium esculentum ssp. esculentum	Native	0.03	0.05			0.08
Arctotheca calendula	Introduced	0.07				0.07
Allocasuarina verticillata	Native	0.06				0.06
Scabiosa atropurpurea	Introduced	0.06				0.06
Hypochaeris radicata	Introduced	0.05				0.05
Melaleuca lanceolata	Native	0.05				0.05

Ecosystem Number 4/5: Coastal white mallee and Sheoak shrubby woodlands/mallee including 4. *Eucalyptus diversifolia* Mallee Communities of the South East and 5. Sheoak (*Allocasuarina verticillata*) low woodland with shrubby understorey

Within this ecosystem type there was a consistently higher number of native species in remnant vegetation than in revegetation (refer to Section 3.0). Introduced species were more prevalent in revegetation sites. Commonly occurring species of high cover in remnant vegetation were all native aside from Bridal Creeper (*Asparagus asparagoides*), and included a variety of life forms such as trees, shrubs, sedges and herbs. Conversely common species of high cover in revegetation sites were all introduced bar the native sedge *Ficinia nodosa*.

Remnant

Sites included in this ecosystem type: 110, 111, 112, 114

Description of ecosystem: This system was characterised by an overstorey comprising *Eucalyptus diversifolia* and/or *Allocasuarina verticillata* with a diverse understorey, comprising small, medium and large shrubs, with sedges and grasses also prominent. Bridal Creeper (*Asparagus asparagoides*) is probably the weed of highest concern in these sites.

Indicative Photographs:

Site 110: *Eucalyptus diversifolia* mallee

Site 111: *Eucalyptus diversifolia* Low Mallee

Number of sites in this vegetation type: 4
Number of quadrats in this vegetation type: 36
Mean native plant species richness per site (±SD): 62.0 (7.8)
Mean introduced plant species richness per site (±SD): 16.0 (9.8)
Mean native plant species richness per quadrat (±SD): 24.9 (5.5)
Mean introduced plant species richness per quadrat (±SD): 6.9 (4.6)

Most commonly occurring species (Proportion of sites):

Native:	Proportion of sites:	Introduced:	Proportion of sites:
Hibbertia riparia	1.00	*Hypochaeris glabra*	1.00
Billardiera cymosa ssp. cymosa	1.00	*Aira sp.*	0.75
Rytidosperma sp.	1.00	*Brachypodium distachyon*	0.75
Acacia pycnantha	1.00	*Anagallis arvensis*	0.75
Dianella revoluta var. revoluta	1.00	*Asparagus asparagoides f.*	0.75
Muehlenbeckia gunnii	0.75	*Ehrharta longiflora*	0.75
Allocasuarina verticillata	0.75	*Plantago bellardii*	0.50
Arthropodium strictum	0.75	*Bromus rubens*	0.50
Austrostipa sp.	0.75	*Sonchus oleraceus*	0.50
Lepidosperma carphoides	0.75	*Ehrharta calycina*	0.50
Acrotriche affinis	0.75	*Petrorhagia dubia*	0.50
Oxalis perennans	0.75	*Trifolium campestre*	0.50
Bursaria spinosa ssp. spinosa	0.75	*Rostraria cristata*	0.50
Austrostipa elegantissima	0.75	*Avena barbata*	0.50
Caladenia sp.	0.75	*Trifolium arvense var. arvense*	0.50
Kunzea pomifera	0.75	*Vulpia sp.*	0.50
Clematis microphylla	0.75	*Brassica tournefortii*	0.50
Lepidosperma congestum	0.75	*Lagurus ovatus*	0.50
Dianella brevicaulis	0.75		
Neurachne alopecuroidea	0.75		
Thysanotus patersonii	0.75		
Rhagodia candolleana ssp.	0.75		
Drosera macrantha ssp. planchonii	0.75		
Schoenus breviculmis	0.75		
Drosera whittakeri	0.75		
Helichrysum leucopsideum	0.75		
Eucalyptus diversifolia ssp. diversifolia	0.75		

Most commonly occurring species (Proportion of quadrats):

Native:	Proportion of quadrats:	Introduced:	Proportion of quadrats:
Eucalyptus diversifolia ssp. diversifolia	0.69	*Asparagus asparagoides f.*	0.64
Lepidosperma carphoides	0.64	*Aira sp.*	0.61
Helichrysum leucopsideum	0.61	*Hypochaeris glabra*	0.58
Clematis microphylla	0.61	*Plantago bellardii*	0.44
Acacia pycnantha	0.58	*Ehrharta longiflora*	0.44
Rytidosperma sp.	0.58	*Ehrharta calycina*	0.31
Lepidosperma congestum	0.56	*Petrorhagia dubia*	0.25
Schoenus breviculmis	0.50	*Briza maxima*	0.25
Billardiera cymosa ssp. cymosa	0.47	*Avena barbata*	0.22
Dianella revoluta var. revoluta	0.47	*Brachypodium distachyon*	0.22
Rhagodia candolleana ssp.	0.44	*Gomphocarpus cancellatus*	0.22
Austrostipa eremophila	0.44	*Anagallis arvensis*	0.22
Xanthorrhoea caespitosa	0.42	*Bromus rubens*	0.19
Hibbertia riparia	0.39	*Trifolium campestre*	0.19
Dianella brevicaulis	0.39	*Trifolium arvense var. arvense*	0.19
Austrostipa sp.	0.39	*Vulpia sp.*	0.19
Trachymene pilosa	0.36		
Muehlenbeckia gunnii	0.33		

Commonly occurring species of high cover (>5%) (Proportion of quadrats):

Species name	Native / introduced	5-25%	26-50%	51-75%	>75%	Total >5%
Eucalyptus diversifolia ssp. diversifolia	Native	0.31	0.39			0.69
Lepidosperma carphoides	Native	0.25				0.25
Allocasuarina verticillata	Native	0.19	0.03			0.22
Xanthorrhoea caespitosa	Native	0.19	0.03			0.22
Eucalyptus fasciculosa	Native	0.17	0.03			0.19
Hibbertia riparia	Native	0.19				0.19
Asparagus asparagoides f.	Introduced	0.19				0.19
Olearia ramulosa	Native	0.14				0.14
Acacia pycnantha	Native	0.11				0.11
Allocasuarina pusilla	Native	0.11				0.11
Gahnia deusta	Native	0.11				0.11
Leptospermum myrsinoides	Native	0.08				0.08
Acacia paradoxa	Native	0.06	0.03			0.08
Callitris gracilis	Native	0.03	0.03			0.06
Acrotriche cordata	Native	0.06				0.06
Bursaria spinosa ssp. spinosa	Native	0.06				0.06
Lepidosperma congestum	Native	0.06				0.06

Revegetation

Sites included in this ecosystem type: 5, 6, 11, 20, 21, 23, 29, 36, 41, 45, 49, 52, 54, 60, 61, 63, 67, 70, 72, 81, 88, 91

Description of ecosystem: Species richness in revegetation sites was low compared with remnant sites. Perennial Veldt Grass was over 5% cover in half of the quadrats, and is likely to be an ongoing competitor with revegetation, especially understorey species. The only commonly occurring native species of high (>5% cover) was the sedge *Ficinia nodosa*.

Indicative Photographs:

Site 5

Site 67

Number of sites in this vegetation type: 22
Number of quadrats in this vegetation type: 198
Mean native plant species richness per site (±SD): 24.2 (7.6)
Mean introduced plant species richness per site (±SD): 23.6 (8.7)
Mean native plant species richness per quadrat (±SD): 7.2 (3.8)
Mean introduced plant species richness per quadrat (±SD): 9.5 (3.8)

Most commonly occurring species (Proportion of sites):

Native:	**Proportion of sites:**	**Introduced:**	**Proportion of sites:**
Allocasuarina verticillata	0.95	*Hypochaeris radicata*	0.91
Rhagodia candolleana ssp.	0.86	*Ehrharta calycina*	0.86
Eucalyptus diversifolia ssp. diversifolia	0.73	*Arctotheca calendula*	0.86
Ficinia nodosa	0.73	*Oenothera stricta ssp. stricta*	0.82
Olearia axillaris	0.73	*Lagurus ovatus*	0.82
Crassula colligata ssp.	0.68	*Trifolium arvense var. arvense*	0.77
Austrostipa sp.	0.64	*Medicago truncatula*	0.73
Enchylaena tomentosa var.	0.64	*Vulpia sp.*	0.73
Callitris gracilis	0.55	*Euphorbia terracina*	0.68
Melaleuca lanceolata	0.55	*Hypochaeris glabra*	0.68
Acacia longifolia ssp. sophorae	0.50	*Reichardia tingitana*	0.68
Dodonaea viscosa ssp. spatulata	0.50	*Bromus diandrus*	0.68
Acacia pycnantha	0.50	*Brassica tournefortii*	0.59
Myoporum insulare	0.45	*Avena barbata*	0.55
Billardiera cymosa ssp. cymosa	0.45	*Marrubium vulgare*	0.50
Rytidosperma sp.	0.45	*Asphodelus fistulosus*	0.45
Muehlenbeckia gunnii	0.41	*Oxalis pes-caprae*	0.45
Bursaria spinosa ssp. spinosa	0.41	*Lolium sp.*	0.41
Carpobrotus rossii	0.41	*Trifolium campestre*	0.32
Eucalyptus incrassata	0.36	*Sonchus oleraceus*	0.32
Pelargonium australe	0.36	*Medicago sativa*	0.32
Kunzea pomifera	0.36	*Scabiosa atropurpurea*	0.32

Most commonly occurring species (Proportion of quadrats):

Native:	Proportion of quadrats:	Introduced:	Proportion of quadrats:
Allocasuarina verticillata	0.59	*Ehrharta calycina*	0.68
Olearia axillaris	0.34	*Euphorbia terracina*	0.51
Rhagodia candolleana ssp.	0.32	*Hypochaeris radicata*	0.48
Eucalyptus diversifolia ssp. diversifolia	0.28	*Oenothera stricta ssp. stricta*	0.46
Crassula colligata ssp.	0.25	*Bromus diandrus*	0.42
Enchylaena tomentosa var.	0.23	*Trifolium arvense var. arvense*	0.41
Ficinia nodosa	0.23	*Arctotheca calendula*	0.41
Austrostipa sp.	0.22	*Medicago truncatula*	0.38
Callitris gracilis	0.19	*Lagurus ovatus*	0.37
Myoporum insulare	0.18	*Hypochaeris glabra*	0.36
Acacia pycnantha	0.18	*Brassica tournefortii*	0.31
Billardiera cymosa ssp. cymosa	0.17	*Reichardia tingitana*	0.29
Pelargonium australe	0.17	*Vulpia sp.*	0.28
Kunzea pomifera	0.16	*Avena barbata*	0.22
Dodonaea viscosa ssp. spatulata	0.15	*Oxalis pes-caprae*	0.19
Acacia longifolia ssp. sophorae	0.15	*Asphodelus fistulosus*	0.19
Melaleuca lanceolata	0.14	*Marrubium vulgare*	0.16
Bursaria spinosa ssp. spinosa	0.12	*Medicago sativa*	0.14
Carpobrotus rossii	0.12	*Lolium sp.*	0.14
		Asparagus asparagoides f.	0.13
		Sonchus oleraceus	0.13

Commonly occurring species of high cover (>5%) (Proportion of quadrats):

Species name	Native / introduced	5-25%	26-50%	51-75%	>75%	Total >5%
Ehrharta calycina	Introduced	0.32	0.14	0.03	0.01	0.50
Euphorbia terracina	Introduced	0.15	0.04			0.19
Bromus diandrus	Introduced	0.17	0.01			0.18
Oenothera stricta ssp. stricta	Introduced	0.11				0.11
Medicago truncatula	Introduced	0.05	0.05			0.10
Cynodon dactylon var. dactylon	Introduced	0.03	0.02	0.02		0.07
Brassica tournefortii	Introduced	0.06	0.01			0.07
Ficinia nodosa	Native	0.06				0.06
Lagurus ovatus	Introduced	0.06				0.06
Medicago polymorpha var. polymorpha	Introduced	0.06	0.01			0.06
Avena barbata	Introduced	0.04	0.01	0.01		0.05
Vulpia sp.	Introduced	0.03	0.03			0.05
Arctotheca calendula	Introduced	0.05				0.05
Oxalis pes-caprae	Introduced	0.03	0.02			0.05

Ecosystem Number: 6 Mallee and Blue Gum Woodlands including 6.1 Mallee Box (*Eucalyptus porosa*) Grassy Woodland, 6.2 Peppermint Box (*Eucalyptus odorata*) Grassy Woodland, 6.3 *Eucalyptus incrassata / E. leptophylla* +/- *E. socialis* Mallee Community and 6.4 *Eucalyptus leucoxylon* Grassy Woodland

Within this ecosystem type there was a consistently higher number of native species in remnant vegetation than in revegetation (refer to Section 3.0). This ecosystem type was the only case where the species richness for introduced species was higher in remnant sites than revegetation sites. The high introduced species richness in remnant vegetation in this ecosystem 6 may reflect that there are few examples of good quality remnants for this ecosystem type left in the region, as it occurs on soils highly suited to agriculture. Species of high cover in remnant vegetation were principally native, and represented a variety of lifeforms including trees, shrubs, climbers/twiners, sedges and herbs. Conversely common species of high cover in revegetation sites were mostly introduced, with the only lifeforms of native species being shrubs and trees.

Remnant

Sites included in this ecosystem type: 115, 117, 118, 128

Description of ecosystem: The four sites surveyed in this ecosystem generally had high species richness, with an average of over 60 species per site. Bridal Creeper and Perennial Veldt Grass were present in all sites, and were also commonly of high cover, and as such are an ongoing threat to the vegetation. Overstorey species for these sites included Mallee Box, Peppermint Box and Blue Gum. Introduced species of high cover included *Plantago bellardii*, Annual and Perennial Veldt Grass (*Ehrharta longiflora, Ehrharta calycina*) and Bridal Creeper (*Asparagus asparagoides*).

Indicative Photographs:

Site 118: *Eucalyptus odorata* woodland

Site115: *Eucalyptus porosa* grassy woodland

Number of sites in this vegetation type: 4
Number of quadrats in this vegetation type: 36
Mean native plant species richness per site (±SD): 62.5 (14.0)
Mean introduced plant species richness per site (±SD): 23.5 (5.3)
Mean native plant species richness per quadrat (±SD): 22.6 (7.4)
Mean introduced plant species richness per quadrat (±SD): 9.4 (2.9)

Most commonly occurring species (Proportion of sites):

Native:	Proportion of sites:	Introduced:	Proportion of sites:
Clematis microphylla	1.00	*Hypochaeris glabra*	1.00
Billardiera cymosa ssp. cymosa	1.00	*Plantago bellardii*	1.00
Oxalis perennans	1.00	*Vulpia sp.*	1.00
Austrostipa sp.	1.00	*Asparagus asparagoides f.*	1.00
Rytidosperma sp.	1.00	*Ehrharta longiflora*	1.00
Thysanotus patersonii	0.75	*Aira sp.*	1.00
Dianella revoluta var. revoluta	0.75	*Bromus diandrus*	0.75
Arthropodium strictum	0.75	*Trifolium arvense var. arvense*	0.75
Bursaria spinosa ssp. spinosa	0.75	*Ehrharta calycina*	0.75
Senecio phelleus	0.75	*Briza maxima*	0.75
Acacia pycnantha	0.75	*Avena barbata*	0.75
Neurachne alopecuroidea	0.75	*Briza minor*	0.75
Crassula colorata var.	0.75	*Trifolium campestre*	0.75
Crassula decumbens var. decumbens	0.75		
Senecio spanomerus	0.75		

Most commonly occurring species (Proportion of quadrats):

Native:	Proportion of quadrats:	Introduced:	Proportion of quadrats:
Clematis microphylla	0.78	*Asparagus asparagoides f.*	0.86
Rytidosperma sp.	0.64	*Ehrharta longiflora*	0.81
Austrostipa sp.	0.50	*Aira sp.*	0.56
Acacia pycnantha	0.50	*Vulpia sp.*	0.53
Billardiera cymosa ssp. cymosa	0.42	*Trifolium campestre*	0.44
Arthropodium strictum	0.42	*Hypochaeris glabra*	0.44
Bursaria spinosa ssp. spinosa	0.39	*Briza maxima*	0.42
Dianella revoluta var. revoluta	0.39	*Romulea sp.*	0.39
Rhagodia candolleana ssp.	0.31	*Plantago bellardii*	0.36
Microseris lanceolata	0.31	*Bromus diandrus*	0.36
Thysanotus patersonii	0.31	*Ehrharta calycina*	0.36
Lepidosperma congestum	0.31	*Briza minor*	0.31
Senecio spanomerus	0.31	*Rostraria cristata*	0.25
Einadia nutans ssp.	0.31	*Asparagus declinatus*	0.25
Astroloma humifusum	0.28	*Moraea flaccida*	0.25
Daucus glochidiatus	0.28	*Hypochaeris radicata*	0.25
Enchylaena tomentosa var.	0.28		
Helichrysum leucopsideum	0.28		
Lomandra multiflora ssp. dura	0.28		

Commonly occurring species of high cover (>5%) (Proportion of quadrats):

Species name	Native / introduced	5-25%	26-50%	51-75%	>75%	Total >5%
Acacia pycnantha	Native	0.36				0.36
Eucalyptus odorata	Native	0.08	0.17			0.25
Ehrharta longiflora	Introduced	0.14	0.08			0.22
Eucalyptus diversifolia ssp. diversifolia	Native	0.17	0.03			0.19
Eucalyptus leucoxylon ssp. leucoxylon	Native	0.19				0.19
Melaleuca acuminata ssp. acuminata	Native	0.03	0.11	0.06		0.19
Asparagus asparagoides f.	Introduced	0.17				0.17
Gahnia deusta	Native	0.11	0.06			0.17
Bursaria spinosa ssp. spinosa	Native	0.14	0.03			0.17
Acacia paradoxa	Native	0.06	0.08			0.14
Eucalyptus porosa	Native	0.14				0.14
Melaleuca uncinata	Native	0.08	0.03			0.11
Asparagus declinatus	Introduced	0.11				0.11
Lomandra effusa	Native	0.11				0.11
Hibbertia riparia	Native	0.08				0.08
Lepidosperma congestum	Native	0.08				0.08
Ehrharta calycina	Introduced	0.06	0.03			0.08
Eucalyptus leptophylla	Native	0.08				0.08
Eucalyptus phenax ssp.	Native	0.08				0.08
Xanthorrhoea caespitosa	Native	0.06				0.06
Eucalyptus incrassata	Native	0.06				0.06
Acacia acinacea	Native	0.06				0.06
Dodonaea baueri	Native	0.06				0.06

Revegetation

Sites included in this ecosystem type: 8, 9, 14, 17, 22, 28, 34, 58, 75, 76, 78, 79, 84, 89, 93, 94, 102

Description of ecosystem: Native species richness was low in these sites when compared to remnant vegetation in the same ecosystem. Grassy and herbaceous weeds were also prominent. The presence of *Distichlis distichophylla* in many sites and quadrats may indicate that there is some overlap with other ecosystems in the sites sampled, as this species is more indicative of lower lying, wetter and usually saline areas.

Indicative Photographs:

Site 8

Site 14

Number of sites in this vegetation type: 17
Number of quadrats in this vegetation type: 153
Mean native plant species richness per site (±SD): 26.8 (4.9)
Mean introduced plant species richness per site (±SD): 19.6 (4.8)
Mean native plant species richness per quadrat (±SD): 7.7 (2.7)
Mean introduced plant species richness per quadrat (±SD): 8.0 (3.1)

Most commonly occurring species (Proportion of sites):

Native:	**Proportion of sites:**	**Introduced:**	**Proportion of sites:**
Allocasuarina verticillata	0.94	*Bromus diandrus*	0.88
Enchylaena tomentosa var.	0.88	*Malva parviflora*	0.82
Melaleuca lanceolata	0.88	*Arctotheca calendula*	0.82
Rhagodia candolleana ssp.	0.76	*Lolium sp.*	0.82
Acacia pycnantha	0.65	*Avena barbata*	0.76
Billardiera cymosa ssp. cymosa	0.65	*Medicago polymorpha var. polymorpha*	0.71
Myoporum insulare	0.59	*Vulpia sp.*	0.71
Maireana brevifolia	0.59	*Medicago truncatula*	0.71
Bursaria spinosa ssp. spinosa	0.59	*Brassica tournefortii*	0.65
Distichlis distichophylla	0.59	*Cynodon dactylon var. dactylon*	0.59
Ficinia nodosa	0.53	*Hordeum leporinum*	0.59
Olearia axillaris	0.53	*Reichardia tingitana*	0.53
Dianella brevicaulis	0.47	*Polygonum aviculare*	0.53
Gramineae sp.	0.47	*Oxalis pes-caprae*	0.53
Salsola australis	0.47	*Trifolium arvense var. arvense*	0.53
Acacia leiophylla	0.41	*Ehrharta calycina*	0.47
Acacia longifolia ssp. sophorae	0.41	*Erodium moschatum*	0.47
Acacia paradoxa	0.41		
Eucalyptus sp.	0.41		
Austrostipa sp.	0.41		
Eucalyptus incrassata	0.41		

Most commonly occurring species (Proportion of quadrats):

Native:	Proportion of quadrats:	Introduced:	Proportion of quadrats:
Allocasuarina verticillata	0.47	*Bromus diandrus*	0.58
Enchylaena tomentosa var.	0.42	*Avena barbata*	0.52
Maireana brevifolia	0.29	*Lolium sp.*	0.49
Melaleuca lanceolata	0.29	*Medicago polymorpha var. polymorpha*	0.37
Gramineae sp.	0.27	*Arctotheca calendula*	0.34
Rhagodia candolleana ssp.	0.25	*Reichardia tingitana*	0.29
Distichlis distichophylla	0.24	*Hordeum leporinum*	0.29
Sonchus sp.	0.21	*Vulpia sp.*	0.29
Eucalyptus sp.	0.20	*Sonchus oleraceus*	0.28
Billardiera cymosa ssp. cymosa	0.19	*Euphorbia terracina*	0.26
Olearia axillaris	0.18	*Brassica tournefortii*	0.25
Myoporum insulare	0.18	*Cynodon dactylon var. dactylon*	0.24
Atriplex semibaccata	0.16	*Malva parviflora*	0.24
Bursaria spinosa ssp. spinosa	0.16	*Medicago truncatula*	0.23
Acacia pycnantha	0.16	*Lagurus ovatus*	0.22
Salsola australis	0.14	*Trifolium arvense var. arvense*	0.22
Ficinia nodosa	0.14	*Plantago coronopus ssp.*	0.20
Acacia paradoxa	0.12	*Oxalis pes-caprae*	0.19
Eucalyptus incrassata	0.12	*Ehrharta calycina*	0.18
Atriplex paludosa ssp.	0.11	*Polygonum aviculare*	0.16
Acacia leiophylla	0.11	*Erodium moschatum*	0.14
		Hordeum marinum	0.14
		Lactuca serriola f.	0.14

Commonly occurring species of high cover (>5%) (Proportion of quadrats):

Species name	Native / introduced	5-25%	26-50%	51-75%	>75%	Total >5%
Bromus diandrus	Introduced	0.22	0.08	0.01		0.31
Avena barbata	Introduced	0.12	0.10	0.03	0.01	0.26
Lolium sp.	Introduced	0.09	0.07	0.02		0.18
Arctotheca calendula	Introduced	0.10	0.01	0.01		0.12
Hordeum leporinum	Introduced	0.08	0.04			0.12
Vulpia sp.	Introduced	0.10	0.01			0.11
Lagurus ovatus	Introduced	0.09	0.01			0.10
Hordeum marinum	Introduced	0.04	0.05	0.01		0.09
Euphorbia terracina	Introduced	0.08	0.01			0.08
Medicago polymorpha var. polymorpha	Introduced	0.08	0.01			0.08
Maireana brevifolia	Native	0.08				0.08
Enchylaena tomentosa var.	Native	0.08				0.08
Ehrharta calycina	Introduced	0.05	0.01	0.01		0.06
Myoporum insulare	Native	0.04	0.01			0.05
Melaleuca lanceolata	Native	0.05				0.05
Sclerolaena muricata var.	Native	0.05				0.05

Ecosystem Number: 9 Samphire (+/- *Melaleuca halmaturorum*) Shrubland Community

This ecosystem differed from all other ecosystems sampled as it showed no differences between native species richness for sites in remnant as compared to sites in revegetation (refer to Section 3.0). This could in part be attributed to many revegetation sites containing remnant native vegetation, which helped to boost the species richness. Common species of high cover in remnant vegetation were principally native, and included lifeforms such as trees, shrubs, sedges and herbs. Introduced species richness in revegetation sites was higher for revegetation sites than remnant sites (refer to Section 3.0). Common species of high cover in revegetation sites included a mix of native and introduced species, with shrubs and trees being the only native plant life forms present commonly as high cover.

Remnant

Sites included in this ecosystem type: 119, 120, 121, 122

Description of ecosystem: Sites allocated in this ecosystem type were characterised by the presence of samphire species. These sites all sat in depressions or drainage lines in the landscape, and would at times be inundated with water. Species richness for both native and weed species was low in comparison to other ecosystems in remnant vegetation.

Indicative Photographs:

Site 119: Samphire Low closed shrubland

Site 122: *Melaleuca halmaturorum* Shrubland

Number of sites in this vegetation type: 4
Number of quadrats in this vegetation type: 36
Mean native plant species richness per site (±SD): 16.8 (4.5)
Mean introduced plant species richness per site (±SD): 6.3 (6.3)
Mean native plant species richness per quadrat (±SD): 6.1 (2.9)
Mean introduced plant species richness per quadrat (±SD): 1.3 (2.3)

Most commonly occurring species (Proportion of sites):

Native:	Proportion of sites:	Introduced:	Proportion of sites:
Samolus repens	0.75	*Sonchus oleraceus*	0.75
Wilsonia backhousei	0.75	*Parapholis incurva*	0.5
Suaeda australis	0.75		
Frankenia pauciflora var.	0.75		
Juncus kraussii	0.75		
Muehlenbeckia gunnii	0.75		
Tecticornia halocnemoides ssp.	0.50		
Senecio glossanthus	0.50		
Distichlis distichophylla	0.50		
Wilsonia humilis	0.50		
Gahnia filum	0.50		
Rhagodia candolleana ssp.	0.50		
Threlkeldia diffusa	0.50		
Chenopodium sp.	0.50		
Melaleuca halmaturorum	0.50		
Sarcocornia quinqueflora	0.50		
Atriplex paludosa ssp.	0.50		

Most commonly occurring species (Proportion of quadrats):

Native:	Proportion of quadrats:	Introduced:	Proportion of quadrats:
Samolus repens	0.50	*Parapholis incurva*	0.22
Sarcocornia quinqueflora	0.47	*Medicago polymorpha var. polymorpha*	0.17
Tecticornia sp.	0.44	*Sonchus oleraceus*	0.17
Suaeda australis	0.42	*Melilotus indicus*	0.08
Frankenia pauciflora var.	0.36	*Cynosurus echinatus*	0.08
Melaleuca halmaturorum	0.31		
Tecticornia halocnemoides ssp.	0.31		
Gahnia filum	0.31		
Wilsonia backhousei	0.25		
Rhagodia candolleana ssp.	0.22		
Wilsonia humilis	0.17		
Chenopodium sp.	0.17		
Distichlis distichophylla	0.17		
Enchylaena tomentosa var.	0.14		
Threlkeldia diffusa	0.14		
Senecio glossanthus	0.14		
Samphire sp.	0.14		
Hydrocotyle sp.	0.14		
Atriplex paludosa ssp.	0.14		

Commonly occurring species of high cover (>5%) (Proportion of quadrats):

Species name	Native / introduced	5-25%	26-50%	51-75%	>75%	Total >5%
Sarcocornia quinqueflora	Native	0.17	0.08	0.06	0.06	0.36
Melaleuca halmaturorum	Native		0.08	0.17	0.06	0.31
Tecticornia halocnemoides ssp.	Native	0.08	0.08	0.14		0.31
Tecticornia sp.	Native	0.11	0.11	0.08		0.31
Gahnia filum	Native	0.17	0.03			0.19
Samolus repens	Native	0.14	0.06			0.19
Suaeda australis	Native	0.11	0.03			0.14
Samphire sp.	Native	0.06	0.03			0.08
Parapholis incurva	Introduced	0.06				0.06
Frankenia pauciflora var.	Native	0.06				0.06
Wilsonia humilis	Native	0.03	0.03			0.06

Revegetation

Sites included in this ecosystem type: 4, 15, 27, 30, 33, 35, 40, 42, 44, 48, 50, 51, 53, 55, 56, 57, 59, 64, 74, 106

Description of ecosystem: Sites allocated to this environmental setting generally still had significant remnancy, with many of the sites having remnant samphire species present (as can be seen from site 4 and 51 photographs below). Native species richness is similar to remnant sites in this ecosystem type. Introduced species richness is higher on average than for remnants, perhaps reflecting that some of these sites are more disturbed than remnant sites, probably from past grazing pressure.

Indicative Photographs:

Site 4

Site 51

Number of sites in this vegetation type: 20
Number of quadrats in this vegetation type: 180
Mean native plant species richness per site (±SD): 17.6 (5.8)
Mean introduced plant species richness per site (±SD): 16.4 (5.3)
Mean native plant species richness per quadrat (±SD): 6.3 (2.9)
Mean introduced plant species richness per quadrat (±SD): 6.3 (2.8)

Most commonly occurring species (Proportion of sites):

Native:	**Proportion of sites:**	**Introduced:**	**Proportion of sites:**
Melaleuca halmaturorum	0.90	*Lolium sp.*	0.80
Atriplex paludosa ssp.	0.90	*Reichardia tingitana*	0.75
Distichlis distichophylla	0.80	*Avena barbata*	0.70
Enchylaena tomentosa var.	0.75	*Hordeum leporinum*	0.65
Disphyma crassifolium ssp. clavellatum	0.70	*Bromus diandrus*	0.60
Myoporum insulare	0.65	*Medicago truncatula*	0.60
Atriplex semibaccata	0.65	*Arctotheca calendula*	0.60
Tecticornia sp.	0.65	*Medicago polymorpha var. polymorpha*	0.60
Suaeda australis	0.60	*Plantago coronopus ssp.*	0.55
Ficinia nodosa	0.55	*Hordeum marinum*	0.50
Maireana oppositifolia	0.50	*Malva parviflora*	0.50
Duma florulenta	0.50	*Bromus hordeaceus ssp. hordeaceus*	0.40
Gahnia filum	0.50	*Sonchus asper ssp.*	0.40
Poa labillardieri var. labillardieri	0.45	*Lagurus ovatus*	0.40
Gramineae sp.	0.45	*Lactuca serriola f.*	0.35
Salsola australis	0.40	*Parapholis incurva*	0.35
Rhagodia candolleana ssp.	0.40	*Vulpia sp.*	0.35
Frankenia pauciflora var.	0.35	*Lycium ferocissimum*	0.35
Samolus repens	0.35	*Melilotus indicus*	0.35
Lawrencia squamata	0.35		

Most commonly occurring species (Proportion of quadrats):

Native:	Proportion of quadrats:	Introduced:	Proportion of quadrats:
Melaleuca halmaturorum	0.53	*Lolium sp.*	0.67
Atriplex paludosa ssp.	0.47	*Medicago polymorpha var. polymorpha*	0.46
Distichlis distichophylla	0.37	*Avena barbata*	0.35
Tecticornia sp.	0.34	*Medicago truncatula*	0.32
Maireana oppositifolia	0.34	*Reichardia tingitana*	0.30
Disphyma crassifolium ssp. clavellatum	0.34	*Hordeum leporinum*	0.28
Enchylaena tomentosa var.	0.29	*Sonchus asper ssp.*	0.26
Gramineae sp.	0.26	*Bromus diandrus*	0.26
Myoporum insulare	0.25	*Plantago coronopus ssp.*	0.24
Atriplex semibaccata	0.23	*Hordeum marinum*	0.23
Gahnia filum	0.21	*Arctotheca calendula*	0.19
Tecticornia pergranulata ssp.	0.16	*Hordeum sp.*	0.17
Suaeda australis	0.16	*Lagurus ovatus*	0.14
Duma florulenta	0.16	*Bromus hordeaceus ssp. hordeaceus*	0.14
Poa labillardieri var. labillardieri	0.16	*Malva parviflora*	0.13
Ficinia nodosa	0.13	*Parapholis incurva*	0.13
Salsola australis	0.13	*Lactuca serriola f.*	0.12
Rhagodia candolleana ssp.	0.13	*Sonchus oleraceus*	0.12
Atriplex suberecta	0.12		

Commonly occurring species of high cover (>5%) (Proportion of quadrats):

Species name	Native / introduced	5-25%	26-50%	51-75%	>75%	Total >5%
Lolium sp.	Introduced	0.22	0.09	0.02	0.03	0.36
Medicago polymorpha var. polymorpha	Introduced	0.20	0.05			0.25
Tecticornia sp.	Native	0.11	0.07	0.01		0.19
Atriplex paludosa ssp.	Native	0.18				0.18
Medicago truncatula	Introduced	0.16	0.01			0.17
Bromus diandrus	Introduced	0.13	0.01			0.14
Avena barbata	Introduced	0.09	0.02	0.03		0.13
Tecticornia pergranulata ssp.	Native	0.08	0.02			0.11
Hordeum marinum	Introduced	0.08	0.01			0.09
Parapholis incurva	Introduced	0.07	0.02			0.09
Plantago coronopus ssp.	Introduced	0.08				0.08
Hordeum sp.	Introduced	0.03	0.04	0.01		0.08
Hordeum leporinum	Introduced	0.04	0.01	0.01		0.06
Distichlis distichophylla	Native	0.04	0.02			0.06
Melaleuca halmaturorum	Native	0.05	0.01			0.06

Ecosystem Number: 10.4 Non Eucalypt (*Allocasuarina verticillata* and *Callitris gracilis*) Grassy Woodland

Within this ecosystem type there was a consistently higher number of native species in remnant vegetation than in revegetation (refer to Section 3.0). There was no significant difference between introduced species richness in remnant and revegetation. Commonly occurring species of high cover in remnant vegetation were all native aside from *Plantago bellardii*, Annual and Perennial Veldt Grass (*Ehrharta longiflora, Ehrharta calycina*) and Bridal Creeper (*Asparagus asparagoides*), and included a variety of life forms such as trees, shrubs, sedges and creepers. Conversely common species of high cover in revegetation sites were all introduced bar the native sedge *Ficinia nodosa*.

Remnant

Sites included in this ecosystem type: 123, 124, 125, 126

Description of ecosystem: Sites in this ecosystem were of woodland form, with either *Allocasuarina verticillata* or *Callitris gracilis* as the dominant overstorey. This ecosystem type had moderate-high diversity of both native and introduced species, but also high variability, with native species richness ranging from 25 to 90. Low shrubs and sedges were prominent features of the ground layer. Bridal Creeper was present in all of the sites surveyed, and Perennial Veldt Grass was present in 3 of the 4 sites. Introduced species of high cover included *Plantago bellardii*, Annual and Perennial Veldt Grass (*Ehrharta longiflora, Ehrharta calycina*) and Bridal Creeper (*Asparagus asparagoides*).

Indicative Photographs:

Site 125: *Callitris gracilis* Woodland

Site 124: *Allocasuarina verticillata* Low Open Woodland

Number of sites in this vegetation type: 4
Number of quadrats in this vegetation type: 36
Mean native plant species richness per site (±SD): 54.0 (30.4)
Mean introduced plant species richness per site (±SD): 16.5 (3.9)
Mean native plant species richness per quadrat (±SD): 22.9 (11.0)
Mean introduced plant species richness per quadrat (±SD): 7.3 (2.6)

Most commonly occurring species (Proportion of sites):

Native:	Proportion of sites:	Introduced:	Proportion of sites:
Calandrinia calyptrata	1.00	*Plantago bellardii*	1.00
Millotia tenuifolia var.	1.00	*Brassica tournefortii*	1.00
Crassula colorata var.	1.00	*Vulpia sp.*	1.00
Acacia pycnantha	1.00	*Asparagus asparagoides f.*	1.00
Podotheca angustifolia	1.00	*Hypochaeris glabra*	1.00
Austrostipa sp.	1.00	*Aira sp.*	0.75
Rytidosperma sp.	1.00	*Zaluzianskya divaricata*	0.75
Dianella revoluta var. revoluta	0.75	*Ehrharta calycina*	0.75
Podolepis tepperi	0.75	*Sonchus oleraceus*	0.50
Muehlenbeckia gunnii	0.75	*Arctotheca calendula*	0.50
Actinobole uliginosum	0.75	*Bromus rubens*	0.50
Daucus glochidiatus	0.75	*Avena barbata*	0.50
Callitris gracilis	0.75	*Rostraria cristata*	0.50
Astroloma humifusum	0.75	*Petrorhagia dubia*	0.50
Clematis microphylla	0.75	*Ehrharta longiflora*	0.50
Neurachne alopecuroidea	0.75	*Silene apetala*	0.50
Crassula colligata ssp.	0.75	*Erodium botrys*	0.50
Pterostylis sp.	0.75	*Trifolium arvense var. arvense*	0.50
Allocasuarina verticillata	0.75	*Gomphocarpus cancellatus*	0.50
Drosera whittakeri	0.75	*Lycium ferocissimum*	0.50

Most commonly occurring species (Proportion of quadrats):

Native:	Proportion of quadrats:	Introduced:	Proportion of quadrats:
Millotia tenuifolia var.	0.81	*Hypochaeris glabra*	0.86
Crassula colorata var.	0.67	*Vulpia sp.*	0.75
Podotheca angustifolia	0.64	*Aira sp.*	0.67
Rytidosperma sp.	0.58	*Plantago bellardii*	0.64
Acacia pycnantha	0.53	*Asparagus asparagoides f.*	0.61
Calandrinia calyptrata	0.53	*Ehrharta calycina*	0.53
Callitris gracilis	0.53	*Brassica tournefortii*	0.39
Daucus glochidiatus	0.47	*Zaluzianskya divaricata*	0.36
Kunzea pomifera	0.44	*Petrorhagia dubia*	0.25
Lepidosperma carphoides	0.44	*Rostraria cristata*	0.22
Enchylaena tomentosa var.	0.42	*Silene apetala*	0.22
Astroloma humifusum	0.39	*Trifolium arvense var. arvense*	0.22
Drosera whittakeri	0.39	*Ehrharta longiflora*	0.19
Austrostipa scabra ssp.	0.39	*Bromus rubens*	0.19
Allocasuarina verticillata	0.39		
Austrostipa sp.	0.39		
Xanthorrhoea caespitosa	0.36		
Blennospora drummondii	0.36		
Microseris lanceolata	0.33		
Thomasia petalocalyx	0.33		
Neurachne alopecuroidea	0.33		
Senecio spanomerus	0.33		
Helichrysum leucopsideum	0.33		

Commonly occurring species of high cover (>5%) (Proportion of quadrats):

Species name	Native / introduced	5-25%	26-50%	51-75%	>75%	Total >5%
Callitris gracilis	Native	0.39	0.06			0.44
Xanthorrhoea caespitosa	Native	0.28	0.03			0.31
Kunzea pomifera	Native	0.25				0.25
Eucalyptus diversifolia ssp. diversifolia	Native	0.11	0.06	0.03		0.19
Acacia pycnantha	Native	0.06	0.08			0.14
Enchylaena tomentosa var.	Native	0.11				0.11
Ehrharta calycina	Introduced	0.11				0.11
Lepidosperma carphoides	Native	0.11				0.11
Allocasuarina verticillata	Native	0.11				0.11
Hibbertia riparia	Native	0.08				0.08
Plantago bellardii	Introduced	0.08				0.08
Allocasuarina pusilla	Native	0.08				0.08
Lepidosperma concavum	Native	0.08				0.08
Asparagus asparagoides f.	Introduced	0.06				0.06
Olearia ramulosa	Native	0.06				0.06
Dodonaea viscosa ssp. spatulata	Native	0.06				0.06

Revegetation

Sites included in this ecosystem type: 3, 25, 31, 39, 65, 66, 69, 80, 104, 105

Description of ecosystem: Species richness was low in revegetation types in this ecosystem type when compared to remnant sites. Sites also had a prominent weedy grass coverage, incorporating both annual and perennial species, with Perennial Veldt Grass (*Ehrharta calycina*) prominent. The only native species that commonly occurred as high cover was the sedge *Ficinia nodosa.*

Indicative Photographs:

Site 25

Site 105

Number of sites in this vegetation type: 10
Number of quadrats in this vegetation type: 90
Mean native plant species richness per site (±SD): 25.8 (7.9)
Mean introduced plant species richness per site (±SD): 21.1 (8.3)
Mean native plant species richness per quadrat (±SD): 7.4 (3.5)
Mean introduced plant species richness per quadrat (±SD): 8.4 (4.1)

Most commonly occurring species (Proportion of sites):

Native:	**Proportion of sites:**	**Introduced:**	**Proportion of sites:**
Allocasuarina verticillata	1.00	*Trifolium arvense var. arvense*	1.00
Enchylaena tomentosa var.	0.90	*Bromus diandrus*	1.00
Callitris gracilis	0.80	*Oenothera stricta ssp. stricta*	0.90
Rhagodia candolleana ssp.	0.80	*Arctotheca calendula*	0.90
Ficinia nodosa	0.70	*Ehrharta calycina*	0.90
Kunzea pomifera	0.70	*Hypochaeris radicata*	0.80
Crassula colligata ssp.	0.60	*Euphorbia terracina*	0.70
Crassula colorata var.	0.50	*Brassica tournefortii*	0.70
Eucalyptus diversifolia ssp. diversifolia	0.50	*Lolium sp.*	0.60
Gramineae sp.	0.50	*Lagurus ovatus*	0.60
Melaleuca lanceolata	0.50	*Oxalis pes-caprae*	0.50
Rytidosperma sp.	0.50	*Hypochaeris glabra*	0.50
Austrostipa sp.	0.50	*Medicago truncatula*	0.50
Dianella brevicaulis	0.50	*Avena barbata*	0.50
Distichlis distichophylla	0.50	*Reichardia tingitana*	0.40
Dodonaea viscosa ssp. spatulata	0.50	*Medicago sativa*	0.40
Bursaria spinosa ssp. spinosa	0.40	*Trifolium campestre*	0.40
Myoporum insulare	0.40	*Lycium ferocissimum*	0.40
Billardiera cymosa ssp. cymosa	0.40	*Polygonum aviculare*	0.40
		Vulpia sp.	0.40

Most commonly occurring species (Proportion of quadrats):

Native:	**Proportion of quadrats:**	**Introduced:**	**Proportion of quadrats:**
Allocasuarina verticillata	0.61	*Ehrharta calycina*	0.79
Enchylaena tomentosa var.	0.44	*Trifolium arvense var. arvense*	0.58
Ficinia nodosa	0.32	*Bromus diandrus*	0.49
Kunzea pomifera	0.28	*Hypochaeris radicata*	0.46
Rhagodia candolleana ssp.	0.26	*Brassica tournefortii*	0.41
Senecio spanomerus	0.23	*Oenothera stricta ssp. stricta*	0.40
Callitris gracilis	0.22	*Euphorbia terracina*	0.40
Crassula colligata ssp.	0.22	*Lagurus ovatus*	0.30
Distichlis distichophylla	0.20	*Arctotheca calendula*	0.29
Gramineae sp.	0.17	*Medicago truncatula*	0.28
Austrostipa sp.	0.16	*Vulpia sp.*	0.26
Dodonaea viscosa ssp. spatulata	0.16	*Lolium sp.*	0.23
Billardiera cymosa ssp. cymosa	0.14	*Vulpia bromoides*	0.18
Melaleuca lanceolata	0.12	*Reichardia tingitana*	0.18
Eucalyptus diversifolia ssp. diversifolia	0.12	*Medicago sativa*	0.17
Olearia axillaris	0.11	*Hypochaeris glabra*	0.16
Rytidosperma sp.	0.11	*Trifolium campestre*	0.14
Bursaria spinosa ssp. spinosa	0.11	*Avena barbata*	0.14

Commonly occurring species of high cover (>5%) (Proportion of quadrats):

Species name	Native / introduced	5-25%	26-50%	51-75%	>75%	Total >5%
Ehrharta calycina	Introduced	0.28	0.29	0.06		0.62
Bromus diandrus	Introduced	0.18	0.04			0.22
Ficinia nodosa	Native	0.11			0.01	0.12
Avena barbata	Introduced	0.07		0.01		0.08
Euphorbia terracina	Introduced	0.06	0.01	0.01		0.08
Trifolium arvense var. arvense	Introduced	0.07				0.07
Medicago truncatula	Introduced	0.04	0.01			0.06

4.0 Discussion:

Native species richness was generally higher in remnant sites than revegetation sites. Sites in samphire vegetation types (ecosystem 9) were the exception to this general rule, with the number of native species roughly analogous. This can in part be attributed to the high degree of remnancy noted for this ecosystem type (i.e. plantings took place in sites where there was already an indigenous flora component present). The general pattern of lower native species richness in revegetation has previously been attributed to the lower diversity of vines/twiners, grasses, sedges and herbaceous species in revegetation sites[3]. Introduced species richness was highest in revegetation in all ecosystem types aside from the samphire community (Community 9), and was also high in remnant vegetation in Community 6 (Mallee and Blue Gum woodlands).

Commonly occurring species of high cover for remnant vegetation included a much greater variety of lifeform types (such as climbers/twiners, sedges, grasses and herbs) than revegetation sites, which were only represented by trees, shrubs and the sedge *Ficinia nodosa*. This is in keeping with previous studies which showed that grasses, shrubs, mat plants and sedges were at densities much lower in revegetation than in remnant sites[3]. This remains an ongoing challenge for revegetation programs, as such lifeforms are likely to provide significant habitat for fauna such as reptiles and butterflies. However, the high density of native species found in remnant vegetation (average of approximately 25,000 individuals per hectare for tree, shrub, grass, sedge and vine lifeforms) mean that mimicking native vegetation by planting at these high densities is likely to be cost prohibitive.

In revegetation commonly occurring species of high cover were most often introduced, with grassy and herbaceous species prominent. The general pattern of comparatively high species richness and cover for introduced species in revegetation sites likely reflect the degrading influences that have operated on these sites, with clearance of remnant vegetation and agricultural practices (grazing, fertilizer use) providing opportunities for colonisation by introduced species. The high introduced species richness in Community 6 may reflect that there are few examples of good quality remnants for this community type left in the region, as it occurs on soils highly suited to agriculture.

However, it should also be noted that the cover of shrub and tree species will increase in revegetation areas, as in most cases the revegetation is still quite young (< 3 years), and as such growth in these species will provide greater cover. Further survey is required to track how well these revegetation sites are performing in future. Whilst (as previously noted) revegetation falls short with regard to providing the range of lifeforms and density of lifeforms (especially for grasses, shrubs, mat plants and sedges) that native vegetation provides, it still is likely to have increased the habitat available for native species. A concurrent study of birds in the CLLMM sites will provide an indication of how successful the provision of habitat through revegetation has been. Future programs may also consider gathering data at sites prior to revegetation activities, so that changes in vegetation and habitat parameters as a result of revegetation could more clearly be quantified.

Eighteen different management issues were identified, with grassy weed competition being the most commonly recorded. Other prevalent management issues included rabbits/hares, and

[3] Milne, T. (2014). Floristic Survey of Poorly Known Remnant Vegetation Types and Revegetation in the Coorong, Lower Lakes and Murray Mouth Region. A report prepared for the Department of Environment, Water and Natural Resources, as part of the Coorong, Lower Lakes and Murray Mouth Recovery Project, December 2014.

herbaceous weeds. Death of tubestock was also considered an issue in 25 of the 80 sites surveyed. Whilst this is not considered to be a comprehensive list of all management issues for the sites (as it is based on a once-off, brief visit to each site), it does provide an indication of some of the ongoing management that will be required. As identified in previous projects[4], the highly competitive, invasive nature of Perennial Veldt Grass is likely to compromise growth and recruitment of revegetation species. Future revegetation programs could consider the current state of the site to help set a realistic goal restoration state. Highly degraded sites, such as those where Perennial Veldt Grass is dominant, are likely to have recovery limited by their initial poor state. In contrast, sites where there are still remnant species or strata present, such as in many of the samphire sites, are likely to have a restoration state that more closely resembles their remnant form. Considering the current and potential restoration state of each site, and prioritising to sites where the restoration state is most desirable, may help improve the overall effectiveness of revegetation efforts. However, it is recognised that in this landscape these opportunities may be very limited, due to extensive past clearance and ongoing agricultural practices.

[4] Milne, T. (2014). Floristic Survey of Poorly Known Remnant Vegetation Types and Revegetation in the Coorong, Lower Lakes and Murray Mouth Region. A report prepared for the Department of Environment, Water and Natural Resources, as part of the Coorong, Lower Lakes and Murray Mouth Recovery Project, December 2014.

Appendix 1: Datasheets and Categorisations used for this Project

Categorisation values

LF = Life form;

T	Trees > 30m	S	Shrubs > 2m	H	Hummock Grass	V	Vines (twiners)
M	Trees 15-30m	SA	Shrubs 1.5-2m	GT	Grass > 0.5m	MI	Mistletoes
LA	Trees 5-15m	SB	Shrubs 1-1.5m	GL	Grass < 0.5m	X	Ferns
LB	Trees < 5m	SC	Shrubs 0.5-1m	J	Herbaceous spp.	MO	Mosses
KT	Mallee tree form (>3m)	SD	Shrubs 0-0.5m	VT	Sedges > 0.5m	LI	Lichens
KS	Mallee shrub form (<3m)	P	Mat plant (single plant)	VL	Sedges < 0.5m		

AD = Flag the dominant/codominant species for Overstorey (up to 3 spp), Emergents (up to 3 spp) and Understorey (up to 5 spp) (O/E/U).
*Note: an emergent species is defined as a species that emerges above the dominant overstorey and has a cover abundance of less than 2.

CA : **Cover Abundance** scale adapted from Braun-Blanquet system.
N = Not many (1-10 plants and <5%) $
T = sparsely present; cover small (less than 5%) $
1 = plentiful, but of small cover (less than 5%)
2 = any number of individuals covering 5-25% of area
3 = any number of individuals covering 25-50% of area
4 = any number of individuals covering 50-75% of area
5 = covering more than 75% of area
where large shrubs or trees are involved upgrade the category to reflect the cover rather than the number of individuals

LS = **Life stages**; enter code where relevant to >10% of that species at site and if >10% of **reproductive organs** are at that stage. Enter **seedlings always.**
V = vegetative
R = regenerating
D = dead/dormant
B = budding
F = flowering
I = immature fruits
M = mature fruits
X = recently shed
S = seedling

Climatic Condition: 1 = wet - rainfall prior to survey, annuals present
2 = dry – vegetation dry, few annuals present

Vegetation Condition: 1 = virtually no cover 2 = undisturbed natural 3 = disturbed natural 4 = degraded natural 5 = highly degraded

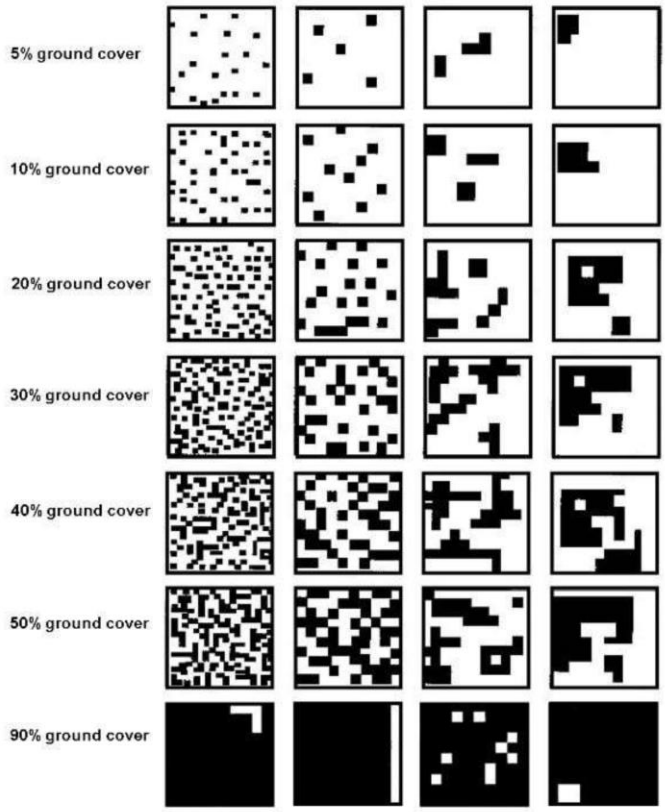

Figure 5: Stylised examples of ground cover proportions.

Various ground cover amounts (%) can be evenly spread across the quadrat or distributed in patches.

Quadrat datasheet

CLLMM Vegetation Survey 2015

Site ID		Observers		Climatic Condition	
Date			15	Vegetation Condition	

	Quadrat no.																																
Live plant cover																																	
Dead plant cover																																	
Moss/microphytic crust																																	
Bare ground																																	
Other:																																	
Species	Voucher	AD	LF	CA	LS	AD	LF	CA	LS	AD	LF	CA	LS	AD	LF	CA	LS	AD	LF	CA	LS	AD	LF	CA	LS	AD	LF	CA	LS	AD	LF	CA	LS
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Management Issues and Photopoint datasheet

Name of photographer/camera: Site number:

Quadrat ID	Photo ID	Quadrat ID	Photo ID	Quadrat ID	Photo ID

Management issues:	Present (Y/N)	Notes
Weed issues		
Domestic grazing		
Feral animals		
Plant death		
Inappropriate species for site		
Other:		
Any specific recommendations		

Appendix 2: Ecosystem Descriptions (reproduced from Jellinek & Te (2015)[5])

Below is a list of all the ecosystems found in the CLLMM region and an explanation of the landscapes they are likely to be found in and the soil types they are associated with. There is a revegetation species list associated with each ecosystem provided below each of the soil maps in the appendices. This species list is for revegetation purposes and is based, where possible, on surveys undertaken in remnant areas.

1. Eucalyptus fasciculosa (Pink Gum) Woodland

This ecosystem is found only in the Mt Lofty Ranges management landscape in the CLLMM region (Bonifacio et al., 2014). It is also found on Kangaroo Island and in the south-east (Nicolle, 2013). It is usually found on lower to mid slopes in poor quality (infertile) sandy soils (Nicolle, 2013) and on flats to low sandy rises in plains and low hills with sand over clay soils (G3 & G4) and/or dune type systems with bleached siliceous sand (H3).

Found associated with *E. baxteri* with an understorey dominated by grasses and sparse shrubs including *Rytosperma s*pp., *Austrostipa* spp., *Lepidosperma* spp., and *Lomandra* spp., *Enchylaena tomentosa, Hibbertia virgata, Muehlenbeckia gunnii, Pimelea humilis* and *Acacia paradoxa.*

Note: On sandy soils this low woodland comprises scrubby smaller *E. fasciculosa* that other eucalypt communities are not strongly associated with. For example, *E. cosmophylla* prefers lateritic infertile loam, while *E. leptophylla* prefers sandy loam soils. *E. leucoxylon* prefers loam soils or shallow sandy soils.

4. *Eucalyptus diversifolia* ssp. *diversifolia* (Coastal White Mallee) Mallee

This ecosystem can occur in all management landscapes of the CLLMM region, but predominantly it is found in the South East and to a lesser extent the Lower Lakes Terrestrial area. Predominantly it occurs on shallow sandy soil on calcrete (B2 & B3) and deep sands (H1 & H3), and to a lesser extent sand over clay (G3 & G5). In rare cases it can also occur on the upper margins of Samphire ecosystems in saline soils (N2) in the South East management landscape. Outcropping calcrete can often be seen.

This ecosystem is dominated by an *E. diversifolia* ssp. *diversifolia* and/or *E. incrassata* overstorey with a heathy-shrubby understorey. Common understorey species include *Xanthorrhoea caespitosa* (SE only), *Lepidosperma carphoides* and *Billardiera cymosa*. It occurs on a wide variety of soil types, so can co-occur with many of the ecosystems described here.

5. *Allocasuarina verticillata* (Drooping Sheoak) Low Woodland

This ecosystem is mainly found in the South East but also occurs in the Lower Lakes Terrestrial management landscape. It occurs on shallow sandy soil on calcrete (B3 & B8) and to a lesser extent bleached sand over sandy clay (G3) bleached siliceous sand (H3) and rarely saline soils (N2).

[5] Jellinek, S. & Te, T. 2015. A guide to restoring the Coorong, Lower Lakes and Murray Mouth region, Adelaide, SA., Vegetation Program, Department of Environment, Water and Natural Resources.

This ecosystem has been severely cleared in the past. It has a shrubby understorey, although may have a grassy understorey in its original state (based on expert opinion). Current remnants have *Allocasuarina verticillata* as the dominant overstorey species with understorey species including *Xanthorrhoea caespitosa* (SE only), *Hibbertia sericea*, *Kunzea pomifera* and *Clematis microphylla*.

Note: The coastal form of this ecosystem has coastal heath or shrub understorey. Elsewhere it tends to be grassy and open.

6. Mixed Eucalypt Woodland/Mallee communities

6.1 *Eucalyptus porosa* (Mallee Box) Grassy Woodland

Found in the Mt Lofty Ranges and Lower Lakes Terrestrial management landscapes in the CLLMM region (Bonifacio et al., 2014) associated with a moderate rainfall in semi-arid areas (Berkinshaw, 2009). Not found in wetter areas on the Mt Lofty Ranges (Nicolle, 2013). It is also found on the Yorke and Eyre Peninsulas, Flinders Ranges and the South-east (Nicolle, 2013)**.**

It is usually found in poorly drained depressions on clay over limestone and coastal limestone bluffs (Nicolle, 2013). In the CLLMM landscape it is associated with loam over poorly structured red clay (D3), shallow calcareous loam on calcrete (B2) or shallow sandy loam on calcrete (B3).

Found associated with *E. fasciculosa*, *E. leucoxylon, E. odorata*, *Allocasuarina verticillata* and *Callitris gracilis* with a sparsely distributed mid and understorey dominated by grasses and sparse shrubs including, *Austrostipa* sp., *Rytidosperma sp.,* Acacia sp., *Dianella revoluta*, *Dodonaea viscosa*, *Clematis microphylla, Oxalis perennans*, *Lomandra effusa* and *Melaleuca* spp.

Therefore, in a bare landscape this ecosystem is most likely to occur in the Mt Lofty Ranges and Lower Lakes Terrestrial management landscapes on level to gently undulating plains but can occur on rises and low hills associated with coastal dune in loam or sandy loan over calcrete (B2 & B3) or sandy loam (D3).

6.2 *Eucalyptus odorata* (Peppermint Box) Grassy Woodland

Found in the Mt Lofty Ranges management landscape in the CLLMM region (Bonifacio et al., 2014) associated with moderate rainfall in semi-arid areas (Berkinshaw, 2009). It is also found on the Yorke and Eyre Peninsulas, South-east and Kangaroo Island (Nicolle, 2013).

This ecosystem is usually found on undulating plains with shallow loamy soils (Nicolle, 2013). In the CLLMM landscape it is associated with loam over poorly structured red clay (D3) and sand over poorly structured clay (G4).

Found associated with *E. fascicolosa, E. leucoxylon* and *E. phenax* with an understorey dominated by grasses and sparse shrubs including *Allocasuarina verticillata, Austrostipa sp., Rytidosperma sp., Dianella revoluta, Clematis microphylla, Oxalis perennans, Lomandra effusa* and *Melaleuca spp*.

Therefore, in a bare landscape this ecosystem is most likely to occur in the Mt Lofty Ranges management landscape on lower to mid slopes (up to 30m elevation) in loam over red clay (D3) and/or sand over clay (G4) soils.

Note: While it can be associated with drainage lines in other locations, in these management landscapes *E. porosa* is more likely to dominate while *E.* odorata tends to be associated with well drained situations at times tops of hills.

6.3 *Eucalyptus incrassata / E. leptophylla +/- E. socialis* Mallee Community

This community occurs on sand over clay soils (G1 & G3) and bleached siliceous sand (H3) in the Mount Lofty Ranges. A mixture of *Acacia* spp and *Melaleuca* spp as well as *E. phenax* can occur in the ecosystem. Common understorey species are *Clematis microphylla*, *Dianella revoluta*, *Rhagodia candolleana*, *Austrostipa* spp., *Lomandra effusa* and *Oxalis perennans*.

6.4 *Eucalyptus leucoxylon ssp. leucoxylon* (SA Blue Gum) Woodland

Found in the Lower Lakes Terrestrial and South East Coorong management landscapes in the CLLMM region (Bonifacio et al., 2014). Only one subspecies occurs in the CLLMM region; *E. leucoxylon* ssp. *leucoxylon* (Nicolle, 2013). *Eucalyptus leucoxylon* ssp. *stephaniae* is probably not found in the CLLMM region but is located inland of the South East Coorong management landscape around Tintinara.

Eucalyptus leucoxylon ssp. *leucoxylon* is usually found in undulating or hilly terrain on loam soils while *E. leucoxylon* ssp. *stephaniae* is found on well drained sandy to loamy soils in shallow depressions surrounded by sand dunes. In the CLLMM region it is found on soils with shallow calcareous loam on calcrete (B2), shallow loam over red clay on calcrete (B6), shallow sand on calcrete (B8) and lesser extent thick sand over clay (G3).

This ecosystem can be found at times associated with *E. cosmophylla, E. fasciculosa, E. odorata, E. diversifolia, E. incrassata, E. leptophylla* and *Allocasuarina verticillata* with a sparsely distributed mid and understorey dominated by grasses and shrubs including *Austrostipa* spp., *Rytidosperma* spp., *Acacia* spp., *Bursaria spinosa, Hakea* spp., *Xanthorrhoea* spp., *Dianella revoluta*, Dodonaea viscosa, *Clematis microphylla, Oxalis perennans*, *Lomandra effusa* and *Melaleuca* spp.

Therefore, in a bare landscape this ecosystem is most likely to occur in Lower Lakes Terrestrial and South East Coorong management landscapes in undulating or hilly terrain on loam soils (G3 - *E. leucoxylon* ssp. *leucoxylon*) or well drained sandy to loamy soils over calcrete, associated with sand dunes (B3, B6, & B8 - *E. leucoxylon* ssp. *stephaniae*).

9. Samphire Swamp (including *Melaleuca halmaturorum* swamp, *Duma florulenta* low shrubland & *Gahnia filum* sedgeland)

Found in all of the CLLMM management landscapes (Bonifacio et al., 2014) and across South Australia. Found in sub-coastal and semi-saline swamps and wetlands, rivers, estuaries and seasonally inundated depressions and floodplains associated with heavy saline soil (N2) and to a much lesser extent wet soil (N3) ranging from deep clays to sand-over-clays to deep sand (Hall et al., 2009)**.**

Samphire swamp is found in wet depressions dominated by *Tecticornia* spp. and surrounded by *Melaleuca halmaturorum*. *Gahnia filum* and/or *Duma florulenta* may also be dominant plant species where N3 wet soils occur. The associated species composition is dependent on the salinity of the standing water and quantity of freshwater run-off.

Therefore, in a bare landscape this ecosystem can be found in all the CLLMM management landscapes which have saline or wet clays, sandy clays or deep sands associated with tidal flats, backswamps, valley floors, closed depressions and drainage depressions. The salinity level of the soil will determine the range of vegetation that will grow in the area. Very saline soils would be dominated by Samphire and *M. halmaturorum* swamps while saline with freshwater run-off would also include *M. halmaturorum* with *G. filum.*

10.4 Non-Eucalypt (*Allocasuarina verticillata* and *Callitris gracilis*) Woodland

Found in the Lower Lakes Terrestrial management landscape in the CLLMM region (Bonifacio et al., 2014). In the CLLMM region it is associated with sub-coastal plains and dunes and steep slopes of low hills (Berkinshaw, 2009) on shallow sandy loam on calcrete (B3).

For the CLLMM region, non-eucalyptus woodland will be dominated by *Allocasuarina verticillata* and/or *Callitris gracilis* with a sparsely distributed mid and understorey dominated by grasses and shrubs including *Austrostipa* spp., *Rytidosperma* spp., A*cacia* spp., *Bursaria spinosa, Hakea* spp., *Xanthorrhoea* spp., *Dianella revoluta, Dodonaea viscosa, Clematis microphylla, Oxalis perennans, Lomandra effusa* and *Melaleuca* spp.

Therefore, in a bare landscape this ecosystem is most likely to occur in the Lower Lakes Terrestrial management landscape on level to gently undulating plains and low hills associated with dunefields in sandy loam soils over calcrete (B3).

Appendix 3: Key Management Issues Identified in each Site

				Management issues																	
iSurveyID	Remnant or reveg	Ecosystem	iPlanName	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	revegetation	1			X	X		X			X	X					X				
2	revegetation	1			X	X	X	X				X						X			
3	revegetation	10			X									X		X					
4	revegetation	9								X											
5	revegetation	4		X	X						X										
6	revegetation	4		X	X							X		X					X		
7	revegetation	1			X																
8	revegetation	6		X	X												X				
9	revegetation	6		X							X						X				
11	revegetation	4		X	X										X			X			
14	revegetation	6			X							X									
15	revegetation	9			X							X									
17	revegetation	6		X	X						X				X				X		X
20	revegetation	4		X	X						X		X		X					X	
21	revegetation	4		X					X		X				X						
22	revegetation	6		X	X										X						
23	revegetation	4		X	X						X										
25	revegetation	10			X		X				X						X				
27	revegetation	9			X	X															
28	revegetation	6		X	X	X					X				X						

Key to management issues: 1=Herbaceous Weeds, 2=Grassy Weeds, 3=Woody Weeds, 4=Vine Weeds, 5=Bulbous weeds, 6=*Juncus acutus*, 7=Domestic Grazing, 8=Rabbits/Hares, 9=Foxes, 10=Kangaroos, 11=Snails, 12=Plant death, 13=Inappropriate species, 14=Tree guards require removal, 15=Buffers need to be sprayed or slashed around plantings, 16=Weeds growing in tree guards and compromising the tubestock within, 17=Dead tubestock never planted or not planted well, 18=Other

				Management issues																	
iSurveyID	Remnant or reveg	Ecosystem	iPlanName	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
29	revegetation	4		X	X						X				X						X
30	revegetation	9		X	X					X											
31	revegetation	10		X	X	X					X	X									
33	revegetation	9		X	X																
34	revegetation	6		X	X										X						
35	revegetation	9			X										X						
36	revegetation	4			X						X				X						
39	revegetation	10			X								X								
40	revegetation	9		X	X								X		X						
41	revegetation	4			X						X							X			
42	revegetation	9		X	X		X								X						
44	revegetation	9		X	X										X						
45	revegetation	4		X	X										X	X					
48	revegetation	9		X		X															
49	revegetation	4		X	X	X	X				X										X
50	revegetation	9		X	X																
51	revegetation	9			X							X					X				
52	revegetation	4		X	X	X					X	X									
53	revegetation	9		X	X	X															
54	revegetation	4		X	X						X										
55	revegetation	9			X	X															
56	revegetation	9		X	X						X				X		X				

Key to management issues: 1=Herbaceous Weeds, 2=Grassy Weeds, 3=Woody Weeds, 4=Vine Weeds, 5=Bulbous weeds, 6=*Juncus acutus*, 7=Domestic Grazing, 8=Rabbits/Hares, 9=Foxes, 10=Kangaroos, 11=Snails, 12=Plant death, 13=Inappropriate species, 14=Tree guards require removal, 15=Buffers need to be sprayed or slashed around plantings, 16=Weeds growing in tree guards and compromising the tubestock within, 17=Dead tubestock never planted or not planted well, 18=Other

				Management issues																	
iSurveyID	Remnant or reveg	Ecosystem	iPlanName	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
57	revegetation	9			X										X		X				
58	revegetation	6			X														X		X
59	revegetation	9			X																
60	revegetation	4		X	X	X					X										
61	revegetation	4		X	X	X	X				X										
62	revegetation	1		X	X								X		X						
63	revegetation	4				X	X	X													
64	revegetation	9		X	X																
65	revegetation	10			X												X				
66	revegetation	10			X	X	X				X										
67	revegetation	4			X	X									X						X
69	revegetation	10		X	X												X				
70	revegetation	4		X	X	X		X			X		X		X			X			X
72	revegetation	4		X	X						X		X		X						
74	revegetation	9			X										X						X
75	revegetation	6			X											X		X			X
76	revegetation	6		X	X																
78	revegetation	6		X	X																
79	revegetation	6				X					X			X							
80	revegetation	10		X	X	X							X			X					
81	revegetation	4									X										
84	revegetation	6		X	X																

Key to management issues: 1=Herbaceous Weeds, 2=Grassy Weeds, 3=Woody Weeds, 4=Vine Weeds, 5=Bulbous weeds, 6=*Juncus acutus*, 7=Domestic Grazing, 8=Rabbits/Hares, 9=Foxes, 10=Kangaroos, 11=Snails, 12=Plant death, 13=Inappropriate species, 14=Tree guards require removal, 15=Buffers need to be sprayed or slashed around plantings, 16=Weeds growing in tree guards and compromising the tubestock within, 17=Dead tubestock never planted or not planted well, 18=Other

				Management issues																	
iSurveyID	Remnant or reveg	Ecosystem	iPlanName	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
85	revegetation	1			X													X			
86	revegetation	1			X	X		X					X			X					
87	revegetation	1			X						X				X			X			
88	revegetation	4		X	X		X				X										
89	revegetation	6		X	X						X										
91	revegetation	4		X	X						X										
93	revegetation	6		X	X	X															
94	revegetation	6		X	X																
99	revegetation	1		X	X								X		X	X					
100	revegetation	1			X		X				X				X						X
101	revegetation	1			X													X			
102	revegetation	6		X		X										X					
103	revegetation	1			X	X	X	X				X	X					X			
104	revegetation	10			X	X					X										
105	revegetation	10		X	X						X										
106	revegetation	9			X										X					X	
107	remnant	1				X		X			X	X	X								
108	remnant	1					X						X								
109	remnant	1		X			X	X													
110	remnant	4		X			X	X				X									
111	remnant	4																			
112	remnant	4		X			X				X										

Key to management issues: 1=Herbaceous Weeds, 2=Grassy Weeds, 3=Woody Weeds, 4=Vine Weeds, 5=Bulbous weeds, 6=*Juncus acutus*, 7=Domestic Grazing, 8=Rabbits/Hares, 9=Foxes, 10=Kangaroos, 11=Snails, 12=Plant death, 13=Inappropriate species, 14=Tree guards require removal, 15=Buffers need to be sprayed or slashed around plantings, 16=Weeds growing in tree guards and compromising the tubestock within, 17=Dead tubestock never planted or not planted well, 18=Other

				Management issues																	
iSurveyID	Remnant or reveg	Ecosystem	iPlanName	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
114	remnant	4			X		X				X	X									
115	remnant	6			X	X	X						X								
117	remnant	6		X			X	X					X								
118	remnant	6			X		X	X													
119	remnant	9																			
120	remnant	9									X										
121	remnant	9		X									X								
122	remnant	9		X			X														
123	remnant	10					X	X													
124	remnant	10					X				X										
125	remnant	10			X	X	X				X										
126	remnant	10					X				X		X								
127	remnant	1			X	X	X						X								
128	remnant	6			X	X	X	X			X										

Key to management issues: 1=Herbaceous Weeds, 2=Grassy Weeds, 3=Woody Weeds, 4=Vine Weeds, 5=Bulbous weeds, 6=*Juncus acutus*, 7=Domestic Grazing, 8=Rabbits/Hares, 9=Foxes, 10=Kangaroos, 11=Snails, 12=Plant death, 13=Inappropriate species, 14=Tree guards require removal, 15=Buffers need to be sprayed or slashed around plantings, 16=Weeds growing in tree guards and compromising the tubestock within, 17=Dead tubestock never planted or not planted well, 18=Other